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Transurethral Surgery

With Contributions by
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and W. Schütz

Translated by A. Fiennes

Foreword by Willard E. Goodwin

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Dedicated gratefully to the three great masters
of American endoscopic urology

ROGER W. BARNES, RUBIN H. FLOCKS, and REED M. NESBIT

who guided my first steps in transurethral urology
more than thirty years ago.

Foreword

In 1951 Wolfgang Mauermayer was one of the first young German urologists to visit the United States, after the war. He brought a very personal enthusiasm, and joy in learning, to many well known clinics in both the eastern and western United States. It was then that I first had the pleasure of meeting him; and, since then, we have enjoyed each other's company on a number of occasions. From California (and during a half year sabbatical in Berlin) I have followed the course of his exceptional career. He has transformed his Munich Clinic into one of the leading European centers for transurethral surgery.

His first book on transurethral operations, published in 1962, appeared only in German. Consequently, it is little known in the United States and England.

The present book, now in its first English edition, is the result of more than 30 years experience in transurethral surgery. During this time more than 10,000 patients were treated in Mauermayer's clinic by various endoscopic operations. His unusual reservoir of experience forms the basis for this book. It seems of particular importance that surgical techniques are described in a number of steps, since this enables even a novice to understand the various procedures.

As I write this, I have not yet seen the English edition, although I am a proud owner of the first German edition. In November 1981, Professor Mauermayer sent me a copy of the German edition and wrote, "The text is formulated as a step-by-step 'TUR Cookbook'". I wrote back to him in December 1981, "Congratulations on your new book (which Dr. Berci has just brought to me). You certainly have covered the subject most completely, I am sure it will become a classic. I think you should ask Springer Verlag if they would consider presenting an *English edition.* I was particularly interested in the clear illustrations which enhance it a great deal".

Subsequently, I talked with editors at Springer and re-emphasized my feeling that this book would be an important contribution, if we could have an English edition.

For many years, Mauermayer has offered courses in transurethral surgical technique in his Munich Clinic, where operations are relayed live over color television to illustrate various methods to those who wish to learn. His extensive teaching experience is repeatedly demonstrated in this book.

He also described many tried and proven "clinical secrets", which are illustrated by means of numerous outstanding drawings. A number of excellent color illustrations at the end of the book demonstrate his impressive cystoscopic photography.

It is an honor and a pleasure for me to write a foreword for this excellent book written by my good friend, Professor Mauermayer. I hope that this textbook will reach a wide audience in the United States and other English speaking countries where it deserves a warm reception.

Los Angeles

Willard E. Goodwin

Preface

This operating manual was written between 1975 and 1981 and bears the same title as a monograph published in 1962. Almost 20 years separate these two books, and in view of the great technical advances made in the last two decades this second textbook has had to be a completely new entity.

One of the most important of these technical achievements was the introduction of Hopkins telescopes, which set totally new standards in providing a previously unknown brilliance and quality of image.

It has been almost equally important to the author not only to be able to watch his younger colleagues at work through a fiberoptic teaching attachment but also to see himself operating on color video recordings. To be able to watch oneself and one's pupils at work is of immeasurable value for the improvement of one's technique and for the recognition of imperfections. The resulting knowledge has been exploited in this book and will, I hope, improve its didactic value.

It is this particular interest in teaching that has given birth to an extensive description of the basic elements of resection technique with diagrams illustrating individual cutting methods. A section on special resection technique describes the surgical strategy to be adopted for various configurations of the bladder neck.

Transurethral operations on bladder tumors and calculi are also discussed, as well as the use of the Zeiss loop and the insertion of indwelling ureteric catheters.

Space is devoted further to specialized forms of electroresection in the treatment of a variety of syndromes, and both pre- and postoperative management are dealt with in depth.

There is a long tradition in the description of operative technique, and most great masters of operative surgery have passed on their knowledge in operating manuals.

In comparison to these manuals of open operative surgery, however, the number of books on transurethral technique is quite modest. The following are only a selection from the host of reasons for this:

1. It is far easier to represent an open surgical procedure in words and pictures, since the operation is equally visible to the surgeon, his assistant and the illustrator.
2. Endoscopic surgery has only become a modern discipline consisting of a number of planned and formalized operations since the early 1940s.

The first monographs by Roger W. Barnes and Reed M. Nesbit both appeared in 1943. Although these excellent books were published only 37 years ago they have already become classics of medical literature.

A further reason lies in the difficulty of adequately describing transurethral operative techniques in words and in sensibly illustrating them. This latter situation has, however, improved considerably since the introduction of high-efficiency telescopes and of fiberoptic illumination and since the availability of usable teaching attachments. All this equipment has rendered photography, cinematography, video recording, transmission of endoscopic procedures an everyday affair. In this respect the demonstrability of endoscopic technique has very considerably approached that of open surgical methods. A number of people may now observe a single operation, and the latter is now easily illustrated by photographs, films, video recordings, and sketch drawings.

Furthermore, anyone who has the opportunity to watch younger surgeons as they operate and to take note of their technical mistakes is then in a very much better position to develop a proper system for teaching what is after all a difficult technique. The author has over 30 years' clinical experience, in the course of which he has trained numerous younger colleagues in the techniques of transurethral surgery as well as introduced a large number of visitors to the basics of transurethral technique. This book owes its present form in part to the many answers given to questions arising during teaching sessions and demonstrations, and in part to an incomparable opportunity to evaluate frequent and typical errors.

The arrival of facilities for observing transurethral operations has transformed a previously more-or-less self-taught art into a fully fledged field of surgical teaching, of which the fundamental techniques may be taught and learned in exactly the same way as those of open surgery.

This book therefore adopts a well-tried teaching system in formalizing and discussing in depth each individual phase of operation.

A variety of practices and maneuvers are presented for imitation, and particular attention is drawn to hazards and possible complications.

I have consciously desisted from any description of the various types of anesthesia suitable for transurethral procedures, since these methods in no way differ from those applicable to surgery in general. The most appropriate technique for any particular occasion is best chosen in close collaboration with the anesthesiologist.

No such operating manual would nowadays be complete without endoscopic color photographs. These serve a purpose wherever they contribute to the description of an individual situation or are superior to words and drawings. Standard modern endoscopes allow such photographs to be taken without much ado during any operation, and the complicated preparations we used to indulge in have become unnecessary. It has thus been possible to record photographically any situation which needed to be illustrated without impairment of asepsis, loss of time, or risk to the patient. Color photographs were selected purely with teaching in mind.

I am indebted to NANCY CLIFF-NEUMÜLLER for the large number of diagrams based on the author's own sketches. She showed great understanding for my various wishes and was of considerable assistance in simplifying and reducing pictorial content to the minimum, with a corresponding increase in teaching value. In some situations this aim could only be achieved by exaggerating certain anatomical configurations. Many illustrations were based on small sketches made while discussing the operation immediately after its conclusion and under the eye of the surgeon. The drawings thus impart a vivid impression of real events.

I therefore wish to express my sincere thanks to Mrs. CLIFF-NEUMÜLLER for her tremendous efforts and her sense of involvement.

To write a book of this size while keeping to a full clinical timetable means sacrifices not only for the author but also for his family, and they deserve my special thanks for the great patience they have shown throughout these years. Whenever I was cross and irritable they were there to encourage me with love and equanimity.

Toward the end Dr. HERBERT LEYH, an associate of our unit, was a great support as a proof reader and in arranging the illustrations throughout the text. He also took over various organizational tasks, thus saving me a considerable nuisance, and for this I owe him special gratitude.

My thanks are also due to Mr. ALBERIC FIENNES, F.R.C.S., for his excellent and rapid English translation of my original German text, which he approached with considerable sensitivity and technical knowledge. It is due to the energy he brought to bear on this task that the present volume has been able to reach the Anglo-Saxon market during 1982.

My colleague, Dr. RAINER KUNTZ, went to great pains in reading through the English text and checking it against the original. In collaboration with Dr. HERBERT LEYH, to whom the index of the German edition is largely due, he also undertook the considerable task of compiling an English index. I should like to thank both gentlemen for their efforts. It is a special pleasure for me to thank my son Andreas for all the photographs of instruments and operation equipment.

Finally I have a special need to thank Dr. H. GÖTZE for the great trust he placed in me by encouraging me to write this book. In this context I should also mention Professor C.E. ALKEN, who lent support to my original idea of writing it.

Despite the business risks involved in publishing a book of this type, Mr. W. BERGSTEDT of Springer-Verlag was tireless in his advice on various organizational matters and in encouraging me to write and illustrate this manual as I thought fit. I am indebted to Springer-Verlag for the sumptuous presentation.

It is my hope that this book will find its way into the hands of those specialist colleagues I aim to help develop a more systematic approach to a difficult technique, thereby enabling them to master it.

Munich WOLFGANG MAUERMAYER

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Chapter A

Operating Facilities for Transurethral Surgery

I. General Considerations

Transurethral surgery should be undertaken in a specially designed and equipped environment. Small cystoscopy rooms were used for much of the pioneer work, but as the technique gained increasingly wide application in surgical and urologic practice the rising number of operations and more rigorous demands for asepsis have made these improvised operating units quite inadequate. This has led to the progressive development of specialized transurethral operating facilities.

MITCHELL (1972) advocated a "combined" operating room suitable both for open surgical removal of large adenomas and for transurethral resection of smaller ones, depending on the findings.

I do not share this view, since the technology nowadays available for transurethral surgery requires so many specific structural features in the operating room that the latter can only really be optimally suitable for one purpose or the other.

This is not, however, to say that a transurethral operating suite should not be equipped for emergency procedures, such as laparotomy following inadvertent surgical perforation of the bladder.

I was able to see an exemplary solution to this problem in the Urology Clinic, Innsbruck, and this provided much inspiration for the planning of our own department at the Rechts der Isar Clinic (MARBERGER 1968, personal communication).

An operating manual such as this can only contain suggestions for the design and equipment of transurethral operating facilities. The suite itself and its location (part of a central operating facility or isolated urologic transurethral operating unit in a urologic clinic) must depend on local requirements and conditions.

II. The Operating Suite for a Transurethral Unit

1. The Operating Room for Transurethral Procedures

The operating theater (Fig. 1) need not be situated along the outside wall of the building. Its illumination may be entirely artificial, and in fact artificial

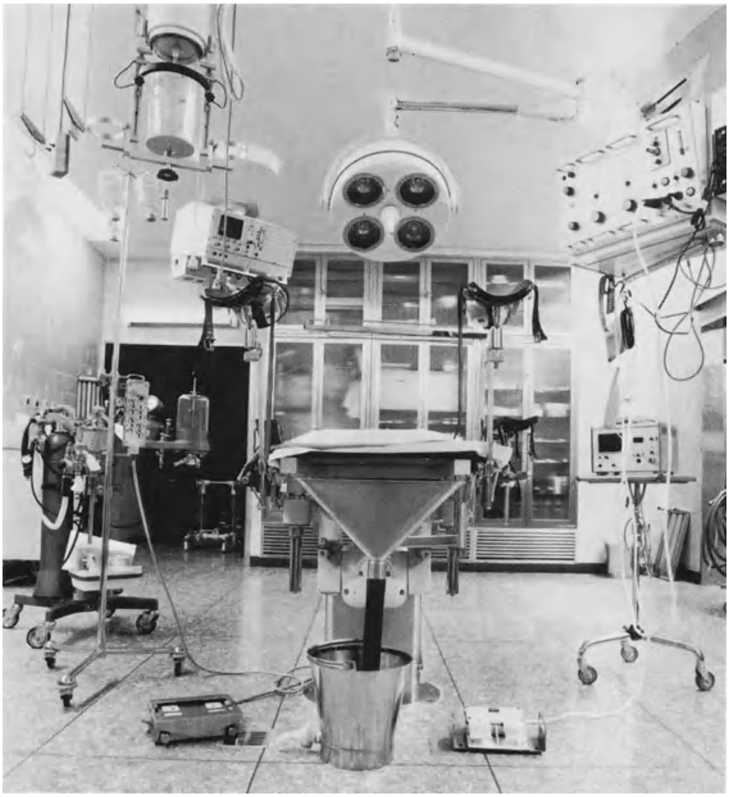


Fig. 1. General view of an operating room for transurethral surgery in our urology clinic (Urologische Klinik rechts der Isar). In the center is seen the Maquet operating table complete with leg rests, showing the collecting funnel, hose and drainage bucket for irrigating fluid. On the floor to the left is the footswitch controlling vertical and Trendelenburg movements of the table, on the right is a footswitch for cutting and coagulating current. The small operating lamp mounted centrally above the table is intended for emergency procedures as well as vasectomies, circumcision and other minor genital surgery such as may arise in conjunction with transurethral procedures. Other apparatus suspended from the ceiling comprises an irrigating fluid supply, an anesthetics module with gas supply and monitoring equipment, and a combined cutting/coagulating diathermy and light source. In the background to the right of the table is a high frequency resistant ECG monitor for pacemaker patients. The far wall is taken up with fitted cabinets for instruments, apparatus and catheters. The doorway leads to the anesthetic room, seen here in darkness

light has the advantage over daylight of being controllable. Since direct sunlight is a nuisance in any endoscopic work a south-facing wall should definitely be avoided. When planning the construction of new buildings a floor area of 30–35 m^2 should be considered adequate.

Welded PVC has stood the test of time as a floor material. Despite hygienic objections a floor gully should still be provided near the operating table. It will, however, be necessary to arrange for its most scrupulous disinfection.

In new buildings, or when completely re-equipping the operating department, a combined high frequency diathermy and cold-light source should be suspended

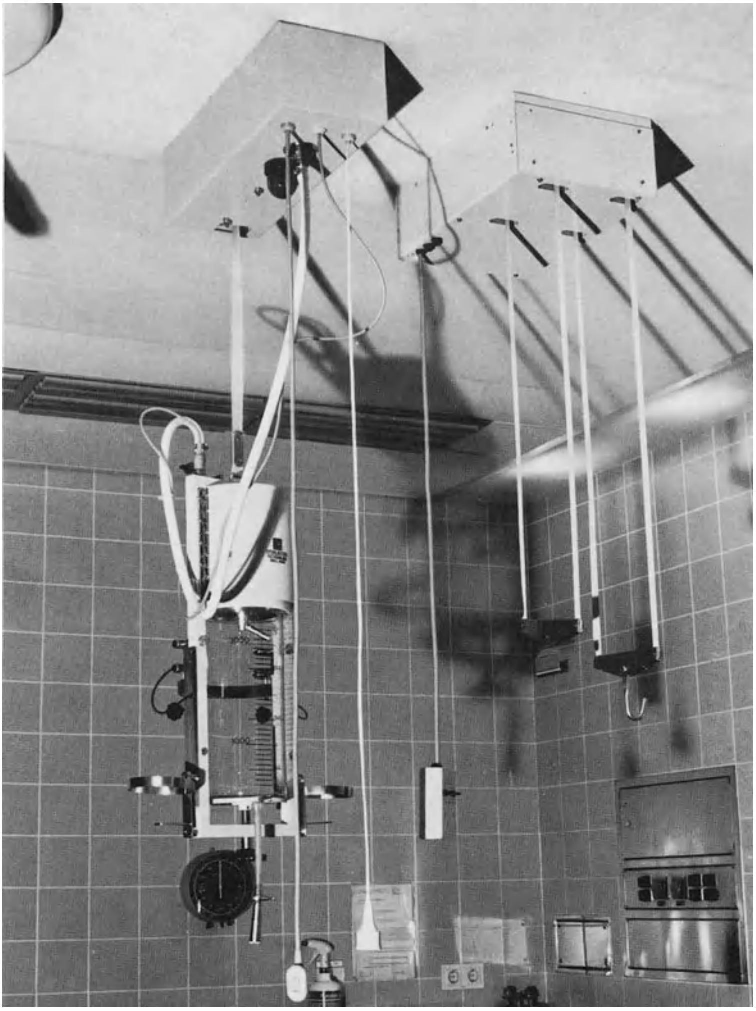


Fig. 2. Sterile irrigation supply. Both sources are suspended from the ceiling. The left-hand apparatus is fully automatic and provides a continuous supply of filtered abacterial with constant isotonicity maintained by the automatic admixture of selected additives. To the right is a motorized hoist for raising and lowering pre-packed irrigation fluid containers of various manufacture. Both systems are attached to the false ceiling, thus facilitating rapid modifications to the system without the need for extensive structural work

from the ceiling, as should irrigation facilities. The latter may consist of apparatus for continuous water decontamination and treatment (equipment either comprising filter apparatus with continuous solute admixture and isotonic output or based on the reverse osmosis principle). Alternatively, there may be equipment for simply raising and lowering suspended bags of irrigation fluid (Fig. 2). A third ceiling unit should supply anesthetic gases, compressed air and vacuum as well as containing modular apparatus for monitoring the ECG and pulse rate.

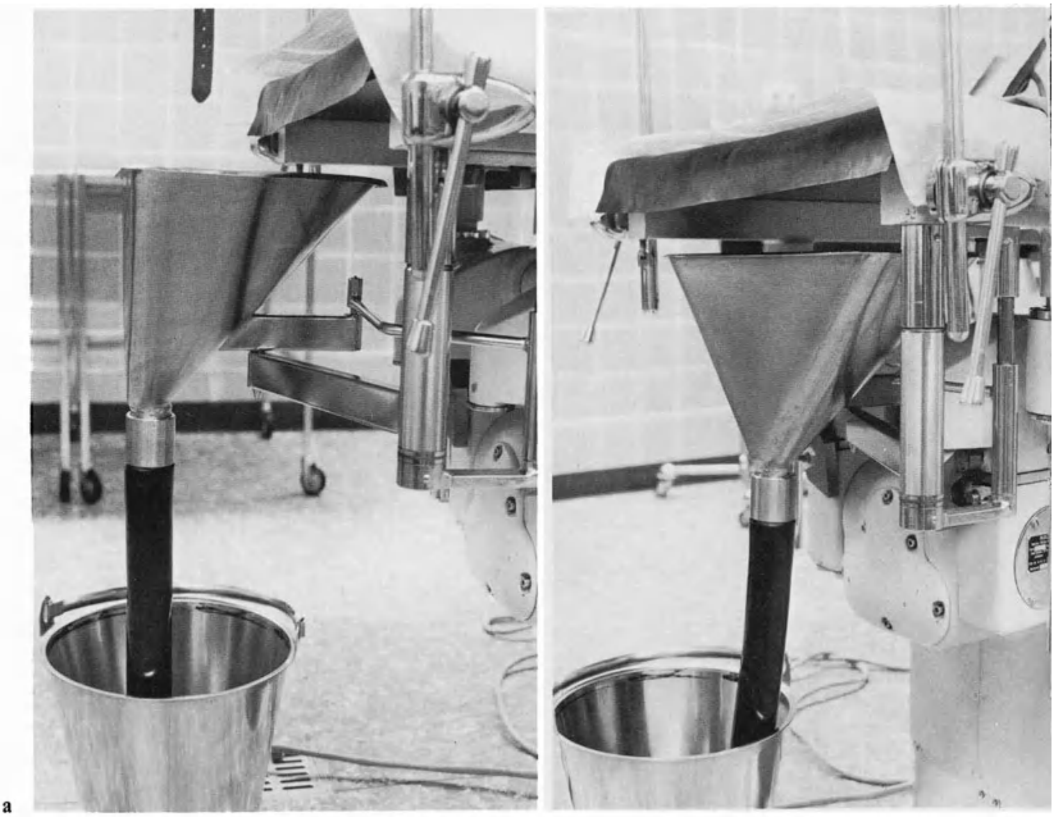


Fig. 3a, b. The re-sterilizable funnel for the collection of irrigation fluid (views showing its attachment to the operating table). In **a** the funnel is shown swung into its extended position, in **b**, it is retracted. During the operation the funnel is covered with its own sterile drape enabling the operator himself to move it into whatever position he requires. The funnel can be removed by simply lifting it off its mounting bracket. Funnel, drainage hose and collection bucket can all be autoclaved

Special attention should be paid to the immunity of ECG equipment to high frequency current induced by the diathermy. High frequency resistant ECG apparatus is commercially available, but at a premium. This aspect of the equipment is of particular importance when operating on patients with cardiac pacemakers, a situation arising ever more frequently.

The operating table itself should be specially designed for transurethral procedures. Special models with a work surface for transurethral surgery have proved of particular value in our practice (MAQUET).

Beneath this work surface is fixed a removable funnel of stainless steel and of dimensions compatible with small autoclave chambers. This collecting device is movable and may be extended or retracted according to individual requirements. Irrigating fluid is thus directed by a plug-on sterilizable hose into a stainless steel bucket of 10 liters capacity and marked in liters (Fig. 3).

The dimensions of the funnel are such that it will fit an autoclave. Two such funnels should be provided for each operating table, so that one may be left to cool after each sterilization cycle. Since some operators prefer standing to sitting, the table must have an adequate range of height adjustment. The Maquet table used in our clinic allows for either working position.

A foot switch allows the operator electrical control of table column height and Trendelenburg tilt.

Adequate cupboard and shelf space must be provided within the operating room itself or in an easily accessible side room to contain the instruments required for transurethral surgery (Fig. 4).

A prepared, sterilized and packed instrument set for emergency laparotomy should also be kept available along with the considerable number of packed instrument sets required for occasional minor procedures (e.g., for circumcision, perineal urethrotomy, vasectomy).

2. The Anesthetic Room

Whenever possible, anesthesia should be induced in a special anteroom in which the patient is transferred from bed to operating table. Otherwise it would be necessary for the patient to be wheeled into the operating theater in his bed.

We use an operating table of which the top may be carried on a special bogey, so that after induction of anesthesia the table top is wheeled into the theater and attached to the operating table column (Fig. 5).

◁ **Fig. 4. A work surface in the operating room.** The cabinet on the left houses essential types of disposable sutures for emergency operations. To the right there is a balance for weighing the operative specimen, and in front of this an apparatus for determining operative blood loss. To the left is a pipette stand containing disposable pipettes and beside it an autopipette for the cyanide solution used in preparing cyanohemoglobin. The blood-loss apparatus seen in the central foreground gives a digital readout of blood loss corrected for hemoglobin concentration

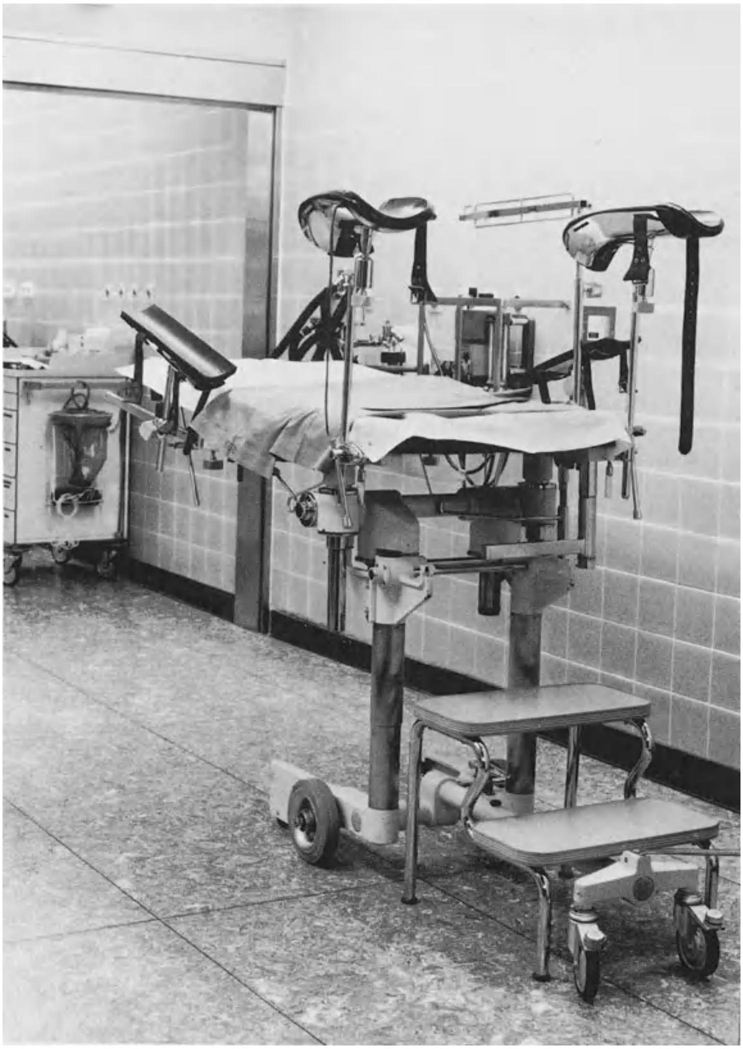


Fig. 5. The mobile operating table top. This is seen here attached to its transport bogey in the anesthetic room. Behind this is the entrance to the operating theater. Anesthesia is induced on this trolley in the anesthetic room, and the patient is usually able to use the small steps to climb onto the operating table. Anesthetic apparatus may be seen in the background. This procedure is used for both regional and general anesthesia, and the patient is then wheeled into the operating theater. The table-top simply locks onto the table column, which then takes over all further functions. Raising and lowering of the table as well as Trendelenburg tilt and all other movements of the table may be controlled either by a footswitch on the floor or by a control module available to the anesthetist

This system has the great advantage that, during induction of anesthesia, the setting-up of instruments and equipment may proceed in the operating theater itself.

This naturally requires the presence of the usual anesthetic gas supplies in the anesthetic room as well as in the operating room. Routine anesthetics are administered from a small, wall-mounted apparatus, thus obviating the need to move equipment with the patient.

The anesthetic room should naturally be genereously provided with cabinets for the storage of anesthetic equipment.

3. The Instrument Room

The cleaning, maintenance and sterilization of endoscopic instruments requires a specialized working area which we shall call the instrument room.

Whenever possible, this room should be so set out as to correspond to the work sequence. Thus the individual steps of instrument preparation such as initial decontamination, preliminary and final mechanical cleaning, disinfection and laying out of instruments for the next operation should be undertaken in sequentially arranged dedicated working spaces.

The overall aim of such an arrangement is easily appreciated from a floor plan drawing (Fig. 6).

The individual procedures are discussed in detail in Chap. B.

The instrument room should also contain equipment for gas and steam sterilization. Hot air is so time-consuming a method of decontamination as to be lapsing into disuse.

The recycling of endoscopic equipment and instruments in a Central Sterile Supply Department can only be accepted if within this department specially trained personnel work at special work places. Otherwise there is a considerable danger of the central sterilizing unit becoming a central instrument liquidation department: Discussions with numerous colleagues have confirmed my conviction that the best alternative remains sterilization in the operating department's own specialized, supervisable and *monitored* working area.

The quality of instrument preparation (and the repair factor) for these delicate instruments is entirely dependent upon the availability of a highly trained team. A single day of inappropriate handling of instruments by an untrained auxiliary may give rise to damage totaling several times that person's monthly salary. One should therefore never economize on first-class personnel.

Gas sterilization using ethylene oxide is nowadays the preferred method of decontamination for endoscopic instruments and optics. The ability of this gas to penetrate plastic foil has opened up the possibility of prior packing and sealing of instruments in plastic sleeves.

Because of the health and safety problems with this technique a number of factors need to be taken into account at the planning stage, e.g., exhaust gas extraction, storage of gas cartridges and the provision of adequate space for the deaeration of sterilized material (deaeration cupboards).

The approximate instrument requirement should be established early in the planning of a new department. This – together with the legal requirements on deaeration times – will determine whether one or two sterilizing chambers need to be provided.

It is of equal importance to provide for an adequate total capacity of carefully exhausted deaeration cupboards.

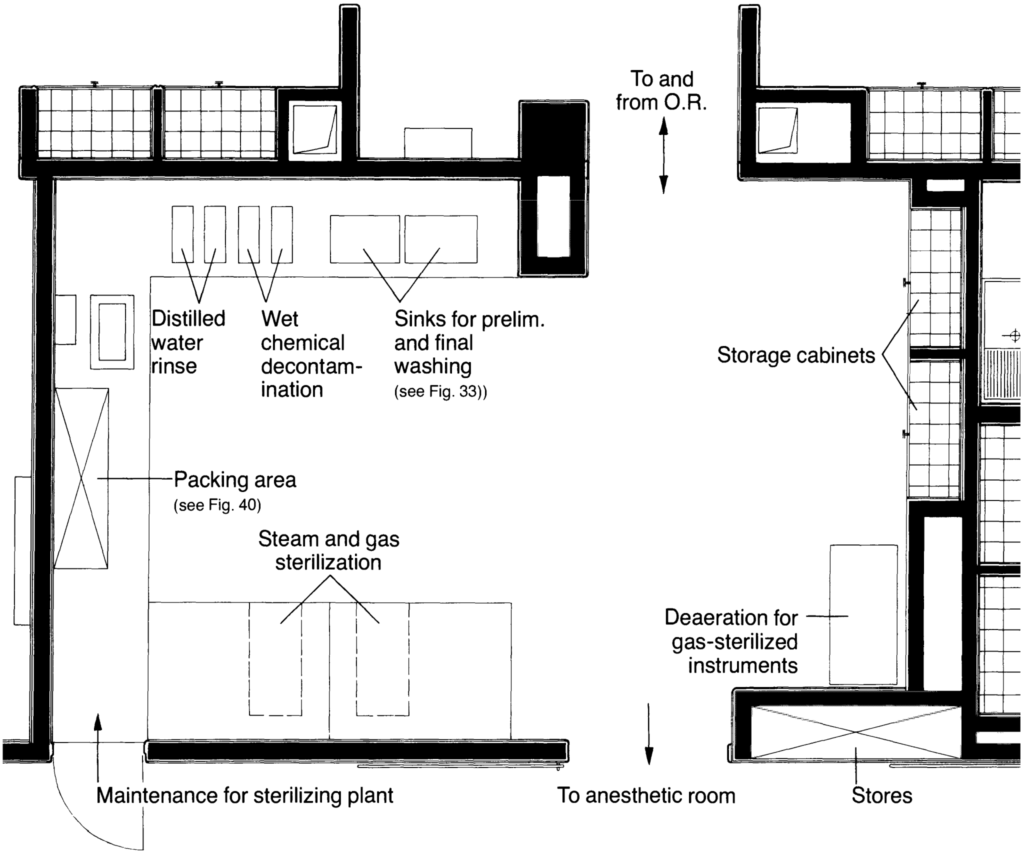
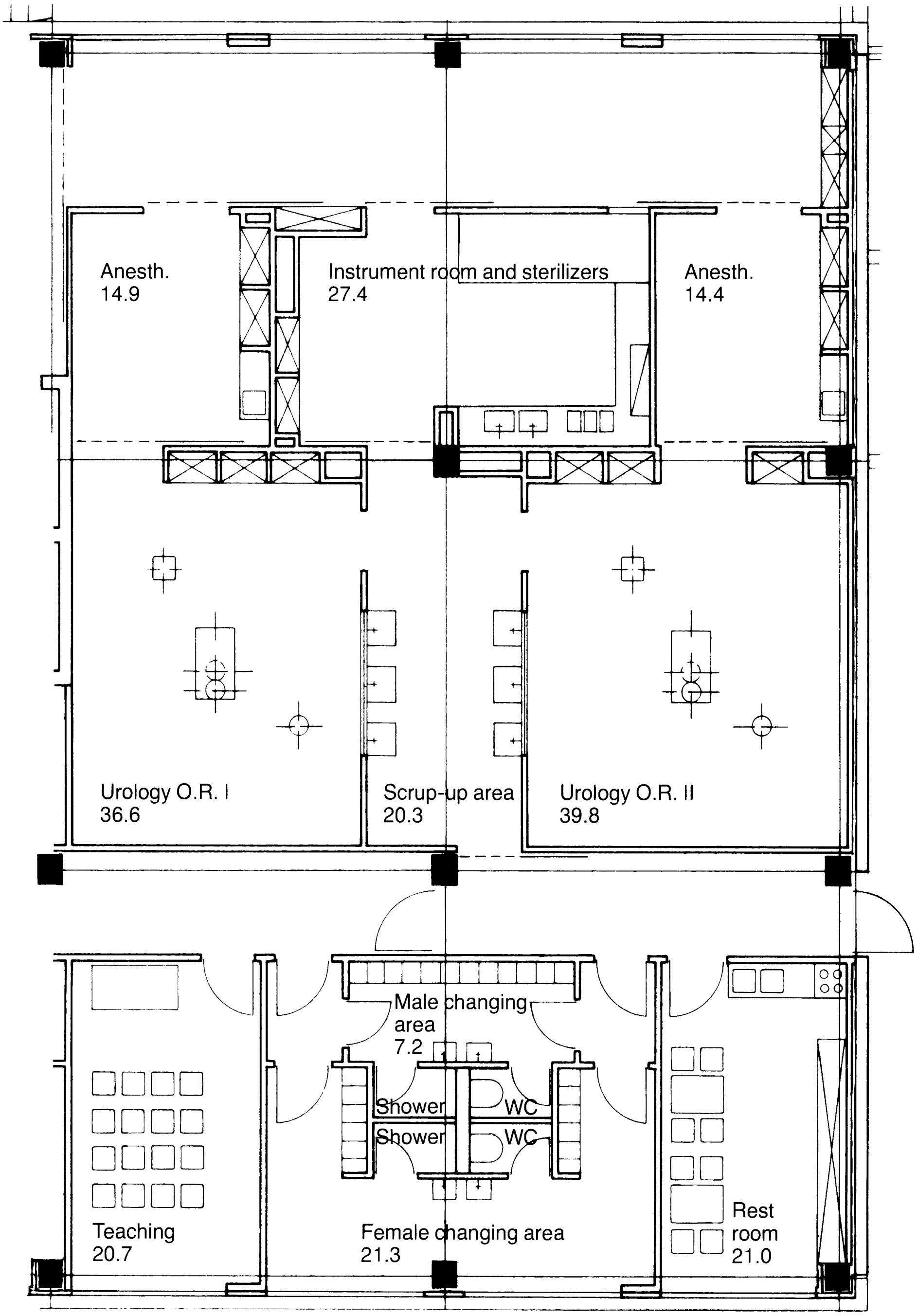

To and
from O.R.
Distilled
water
rinse
Wet
chemical
decontam-
ination
Sinks for prelim.
and final
washing
(see Fig. 33))
Storage cabinets
Packing area
(see Fig. 40)
Steam and gas
sterilization
Deaeration for
gas-sterilized
instruments
Maintenance for sterilizing plant
To anesthetic room
Stores

Fig. 6. Floor plan of the instrument room. This workroom is divided into a wet and dry side. In the wet area the instruments are washed, cleaned and subsequently prepared for reuse by soaking in disinfectant solution. On the dry side instruments are packed in plastic foil and sterilized by gas or steam

We have completely abandoned boiling as a method of sterilization, although numerous instrument companies manufacture optical systems suitable for this process.

An autoclave should be provided for subsidiary sterilization in the endoscopy instrument room. As already mentioned, we use this equipment for sterilizing the operating table funnel, rubber goods and pure metal instruments. The advent of disposable drapes has led to reduced linen requirements.

Fig. 7. Floor plan of our transurethral operating suite (Urologische Klinik rechts der Isar). An airlock system allows entry to the unit via the changing rooms, showers and lavatories for male and female personnel. The scrub-up area may be reached by crossing a corridor, and this then allows access to the two transurethral operating theaters. Room I is designed primarily for sterile and aseptic procedures and Room II is reserved for infected patients. The scrub-up area also gives access to the instrument room. The activity in this area is to be further described in detail in Chap. B. Patients reach the operating theaters via the anesthetic room, and the transition from bed to operating table is made at the threshold of the entry corridor to the anesthetic room. All working areas are liberally equipped with fitted cabinets


Anesth.
14.9
Instrument room and sterilizers
27.4
Anesth.
14.4
Urology O.R. I
36.6
Scrup-up area
20.3
Urology O.R. II
39.8
Male changing
area
7.2
Shower
Shower
WC
WC
Teaching
20.7
Female changing area
21.3
Rest
room
21.0

4. Ancillary Rooms

However small an endoscopic operating suite may be, additional rooms will be required for the storage of standby equipment, stores and rarely used instruments.

It is thus mandatory to have a standby high frequency diathermy available, since failure of this apparatus at a moment of vigorous hemorrhage may represent the gravest hazard to the patient and may even lead to an emergency open procedure to underrun the prostatic capsule or resection point of a bladder tumor.

5. The Recovery Area

Patients undergoing prostatic or bladder tumor surgery require intensive monitoring in the immediate postoperative period, particularly if operative hemostasis has not been entirely successful. A recovery and monitoring room should therefore be situated close to the operating theater, so that the patients may be seen between operations by the surgeon and the function of the catheter and degree of hemorrhage be monitored by trained personnel.

For this purpose we have provided anesthetic gases and monitoring equipment so that up to four patients can be recovered in their beds in the broad entry corridor outside the anesthetic rooms at the same time.

6. The Siting of Transurethral Operating Suites

In large hospitals not built on the pavilion principle, a transurethral suite may be located within a central operating department or may be accommodated in a decentralized fashion within the urology department.

There are negative and positive aspects of either solution. Personally I prefer the decentralized variant, since this enables the combination of endoscopic operating and examination facilities with a urologic X-ray department. Such an arrangement would also allow particular attention to the important aspects of endoscopy. It does, however, go without saying that the suite described above may equally be set up within a central operating area. Under these circumstances it is essential that the instrument room with its specialized facilities for sterilization and care of delicate equipment remains part of the operating suite. Figure 7 demonstrates by the example of our own clinic a typical layout of operating and ancillary rooms. Such a unit may easily be placed within a large central operating department.

Chapter B

Instruments and Their Care

I. Instruments for Transurethral Surgery

1. Diagnostic Instruments

Among the range of instruments available for diagnostic purposes the so-called panendoscope has nowadays found general application. The chief feature of this instrument is its ability to examine the urethra, prostatic urethra and bladder through a single sheath. For these purposes a slightly forward-viewing telescope (30° Storz or 155° Wolf) is generally adequate. It is only cases in which protruding lobules of adenoma prevent a full view of the bladder that require lens systems with more acute angulation of the optical axis. In fact under some circumstances retrograde-viewing telescopes may be required. The narrow caliber diagnostic instruments manufactured by Storz direct irrigating fluid in a jet toward the bladder wall, which is thereby indented somewhat. Thus these instruments allow the bladder wall to be palpated with a water jet (see Ch. G.IV.5.d.).

Such instruments, available in a range of diameters from 15–18 Ch, also permit minor endoscopic procedures such as retrograde injection, coagulation of small bleeding vessels or minute papillomata as well as excision biopsy by means of fine forceps. Depending on the overall diameter, the instrument channel in these cystoscopes measures 5–6 Ch (Fig. 8).

Nevertheless, their chief application is purely diagnostic.

2. Operating Cystoscopes

This term embraces all those instruments of which the operating channel will accept wide-bore probes and special attachments for the introduction of small operating instruments into the bladder (Fig. 9).

Various manufacturers offer these instruments in sizes ranging from 20 to 24 Ch.

Such instruments permit the comminution of small and soft stones by means of small forceps, excision biopsy and even the fragmentation of larger stones with the hydraulic lithotrite.

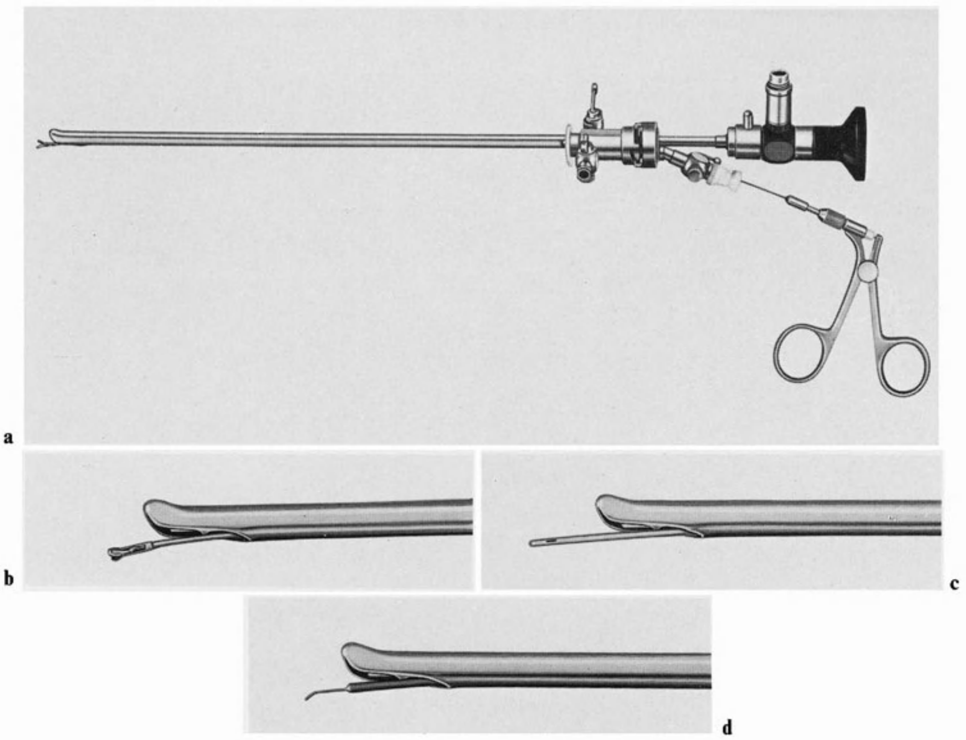


Fig. 8a–d. A diagnostic cystoscope with a 5 Ch operating channel. This instrument, of only 15.5 Ch diameter, is able to accept the manufacturer's entire range of telescopes. It is thus not only suitable for a comprehensive examination of bladder and urethra but also allows minor diagnostic and therapeutic procedures. **a** General view of the instrument with a 5 Ch. miniature biopsy forceps in situ. **b** Detailed view of the vesical end showing the same biopsy forceps. **c** As above, but with a ureteric catheter introduced. **d** The cystoscope equipped with a hooked probe. Alternative equipment includes a fine injection needle for local anesthesia of small areas of the bladder mucosa and a fine coagulating wire

Generally speaking, however, the repertoire of the operating cystoscope has been considerably diminished by the advent of true transurethral resection instruments. This development has been particularly fruitful in the treatment of bladder tumors by coagulation, since this had not previously been adequately radical. Of equal importance in this respect are the so-called coagulating cystoscopes with their retrograde-viewing and operating facilities (Fig. 10).

It is important to note that these working attachments may also be introduced through the resectoscope sheath. There has thus been a development towards the concept of a modular instrument set.

All these instruments will accept the full range of available telescopes, from pure forward- to retrograde-viewing.

An intermediate position between operating cystoscope and resectoscope is occupied by an instrument described by ENGBERG (unpublished). This narrow caliber resectoscope (Fig. 11) has an additional special channel allowing the

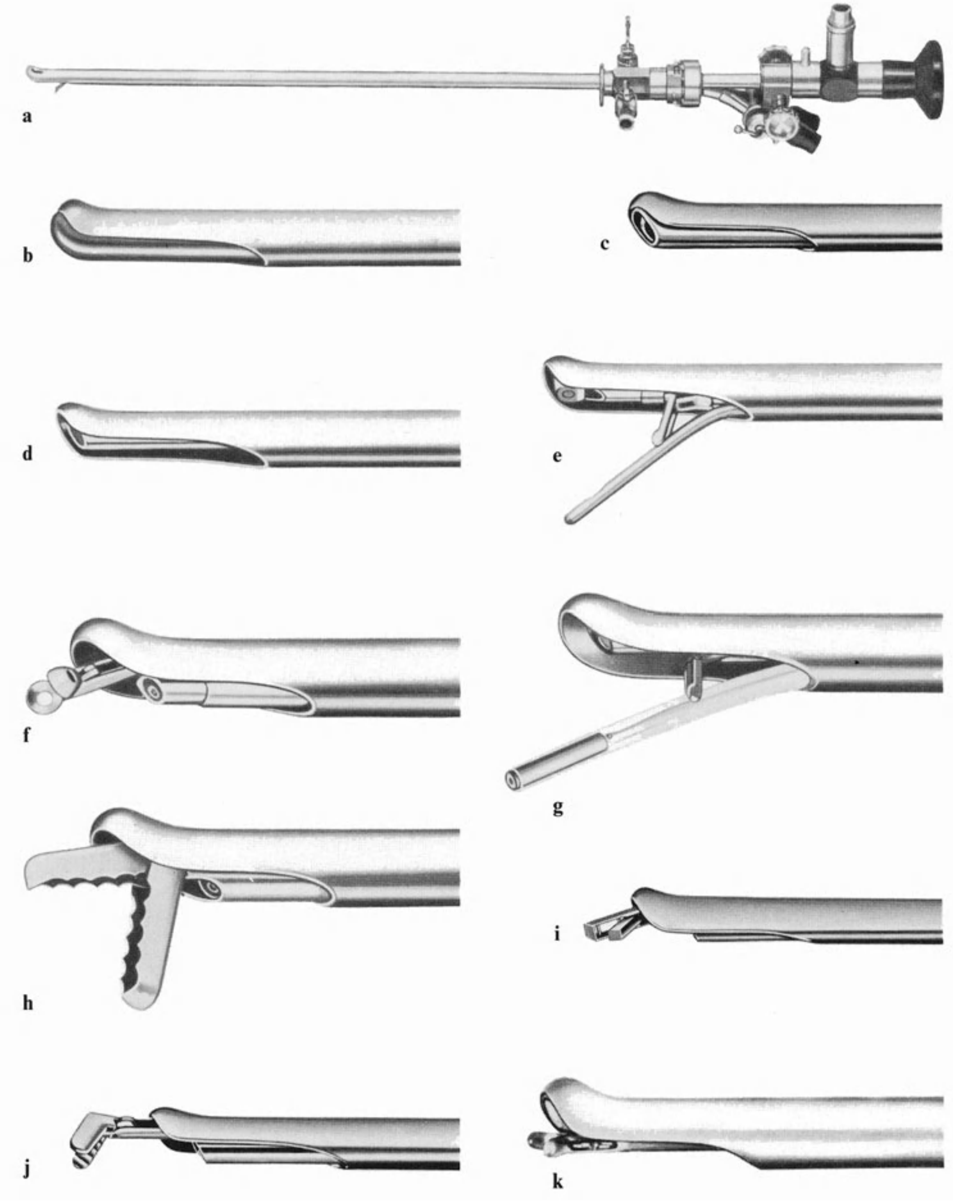


Fig. 9a–k. 23 Ch operating cystoscope. a General view of the instrument. **c–k** A variety of diagnostic and operative accessories. **b** Vesical end of the instrument closed off by the obturator for blind instrumentation. **c** The same instrument containing a viewing obturator enabling urethroscopy during introduction of the sheath. **d** A diagnostic telescope in situ. **e** Cystoscope with 70° telescope and ureteric catheter controlled by the Albarran lever. **f** Rigid biopsy and operating forceps. Note the gouge-shaped jaws enabling biopsies to be taken with minimal tissue trauma. **g** Operating insert with forward-viewing telescope and Urat probe for shock-wave litholapaxy. **h** Heavy forceps for the removal of small stone fragments and foreign bodies. **i** Punch biopsy forceps with cutting jaws. **j** Small rigid foreign body forceps. **k** Flexible biopsy forceps similar to those in Fig. 8a and b

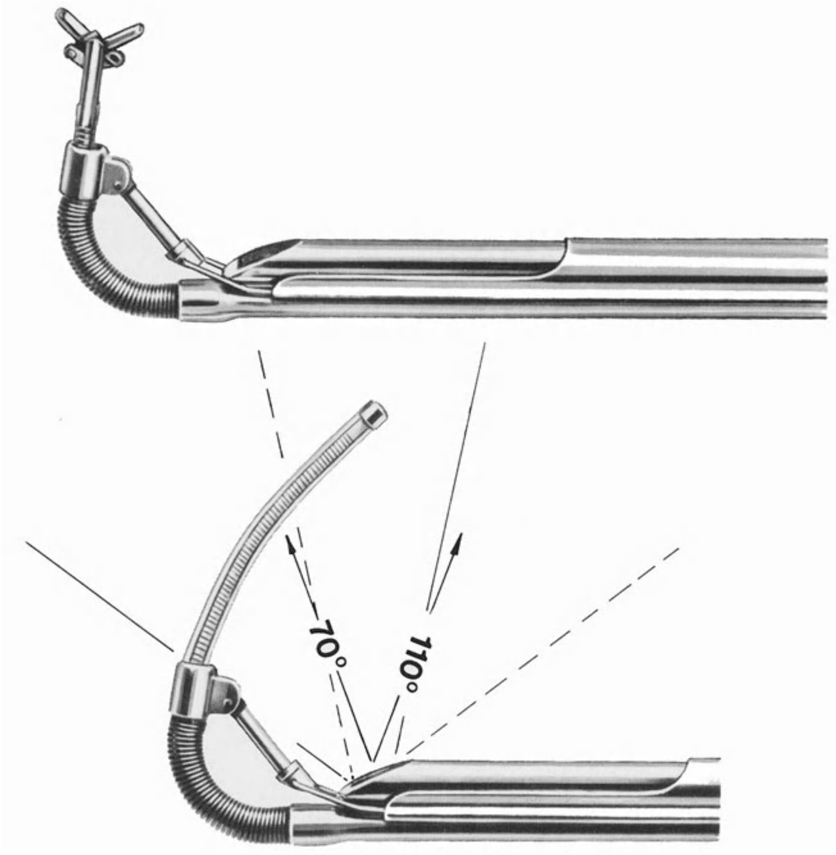


Fig. 10. Retrograde coagulating cystoscope (Wolf). This instrument is designed for coagulating small tumors in the region of the internal meatus. A special biopsy forceps may be passed through the flexible operating channel in order to obtain biopsies prior to coagulation

introduction of a local anesthetic needle into the bladder, and a cutting loop permits the resection of small bladder tumors.

The instrument has been designed chiefly for the ambulant treatment of tumor recurrences without the need for hospital admission. It has the further advantage that its small diameter should be less traumatic to the urethra. Our initial experience has been entirely positive.

3. Water Connections for Diagnostic and Operating Cystoscopes

For many years it was customary in English-speaking countries to use Luer-lock connections for irrigating fluid. With the increasing availability of German-made

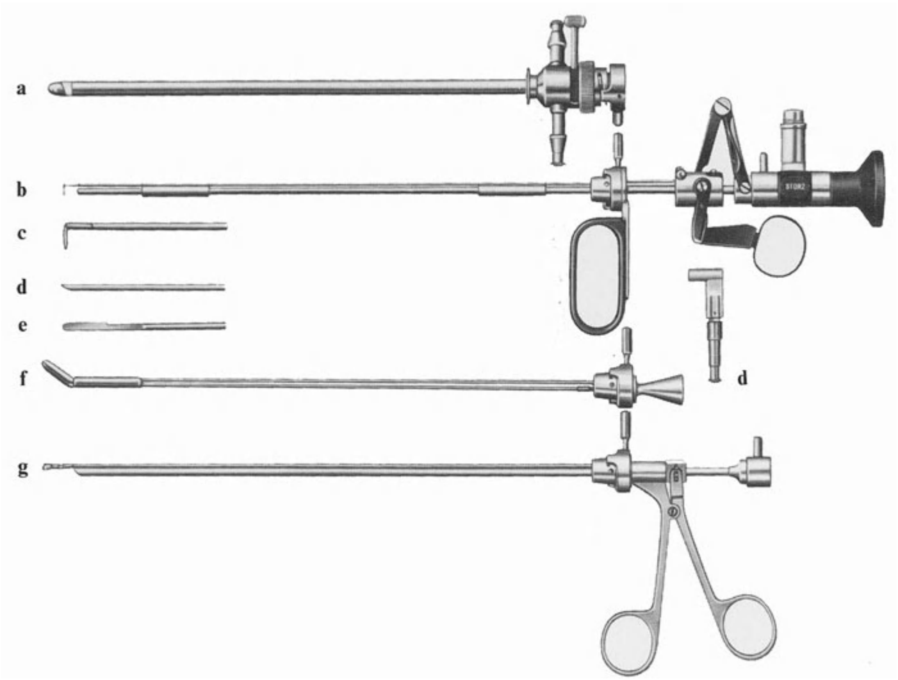


Fig. 11a–g. Transurethral operating instrument after Engberg. This 20-Ch instrument was developed primarily for outpatient use. The various accessories enable minor resections to be carried out under local anesthesia. An injection cannula may be inserted for the infiltration of local anesthetic under small bladder tumors. A rigid biopsy forceps is available for use in place of the electrotome. **a** Sheath and obturator. **b** Electrotome with small cutting loop and special small caliber operating telescope (3.5 mm/0.14″ diameter). **c** Detail of cutting loop. **d, d′** Detailed view of the injection cannula and its connection hub. This cannula may be introduced in place of the cutting loop. **e** Urethrotome blade for cold urethrotomy under direct vision. **f** Timberlake type hinged obturator. **g** Rigid biopsy forceps to be introduced in place of the electrotome

instruments in these countries the three-way cock system has gained ground (Fig. 12).

My personal preference is for a three-way cock, since it requires considerably fewer cleaning and maintenance maneuvers during instrument preparation, and in use its attachment and removal are accomplished more quickly. Irrigation of the bladder is achieved by means of a single control, while Luer-lock connections require the manipulation of at least two levers.

4. Electro-resectoscopes

Resectoscopes produced by various manufacturers all over the world have taken on a measure of similarity, although certain makers offer particularly convenient special equipment.

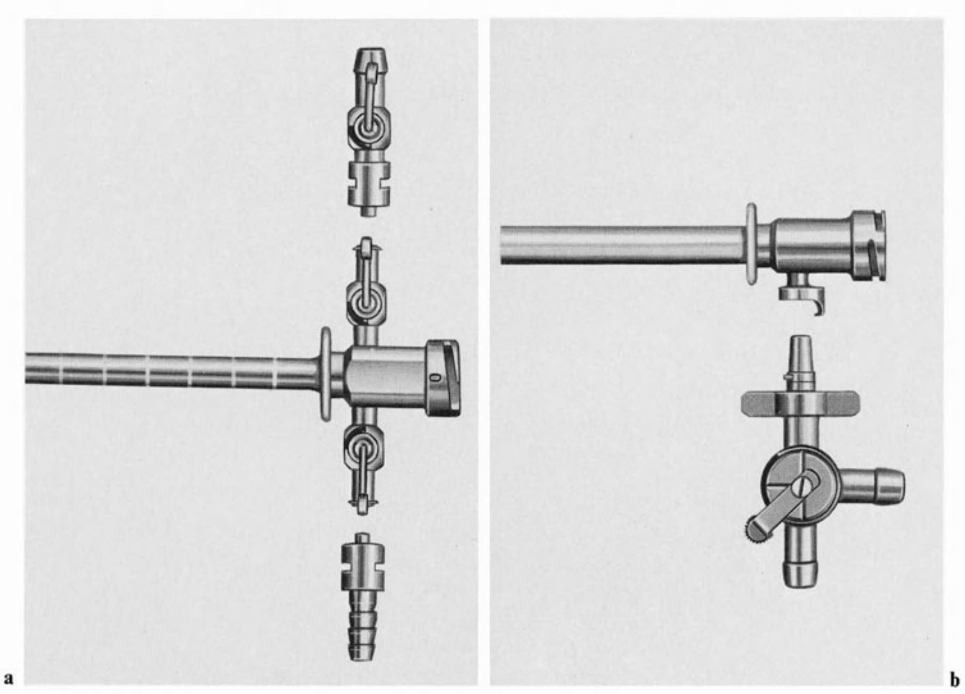


Fig. 12a, b. Two different types of water connection for diagnostic instruments. a Luer-lock connection. **b** The three-way cock and bayonet connector system preferred by us for its speed of operation (see text)

a) The Resectoscope Sheath

The resectoscope sheath generally consists of a cylindrical metal tube, the vesical end of which is protected from the current pathway by a ring of insulating material.

The vesical end is available in a variety of similar contours ranging from long beak to minimal obliquity (Fig. 13).

α) Insulation-Coated Sheaths. The sheath for the original Stern-McCarthy instrument was made of insulating material (Bakelite). European manufacturers and users have always preferred metal sheaths. For some years now, resectoscope sheaths with a Teflon coating have also been available with noteworthy variations in quality, ranging from a thin film on the sheath to its investment with a continuous, homogeneous Teflon sleeve. This point is of considerable importance, since small defects in the Teflon coating may give rise to dense leakage currents. It is therefore important to test the integrity of this insulation periodically. These Teflon coatings were introduced in an attempt to prevent transfer of high frequency current induced in the metal sheath by the cutting loop. The insulating ring at the vesical end may be made from a variety of materials. We prefer a ceramic substance which has equally excellent mechanical and elec-

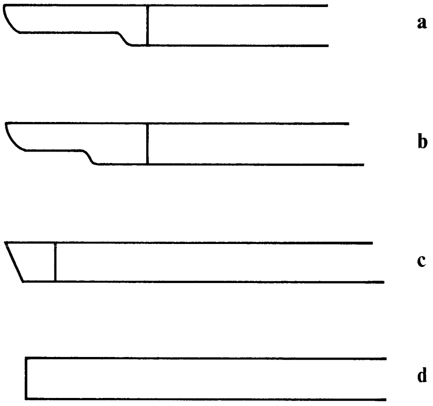


Fig. 13a–d. Various contours available for the vesical end of resectoscope sheaths. a Long beak. **b** Shorter version of the same. **c** Oblique-ended sheath. **d** Straight-ended sheath. We prefer type **d** for our instruments since it renders them most versatile in use. We have entirely dispensed with protective beaks (**a**, **b**) since they render proper resection of small prostatic adenomas considerably more difficult

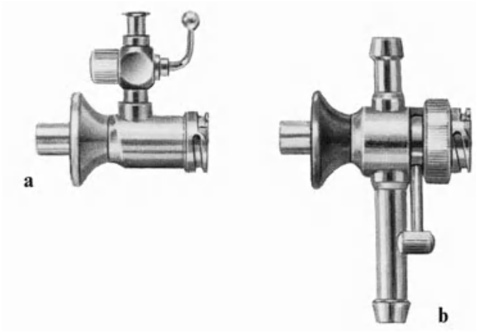


Fig. 14a, b. The external end of resectoscope sheaths. a Irrigation inlet by Luer-Lock connector. There is no separate outlet port. Irrigation fluid leaves through the open end of the sheath. **b** Central three-way cock fitted to a resectoscope sheath, showing inlet and outlet ports (see text). Connections are made by attachment of standard push fit hoses

trical properties. The introduction of these materials has virtually eliminated the need for repairs to the sheath aperture.

Teflon is a water-repellant substance. Water-soluble lubricants will therefore not adhere to the sheath collar, and special Teflon-compatible lubricants should be used.

Resectoscope sheaths are available in sizes from 22–28 Ch. We prefer a 24 Ch instrument so as to spare the urethra.

β) The External End of the Resectoscope Sheath. The external end of the resectoscope sheath consists of irrigation fluid connections and, depending on the type of instrument, the mechanism for locking the electrotome into the sheath (Fig. 14).

In the simplest form, therefore, there is only a water-inlet port and stopcock. Drainage is through the open end of the sheath after removal of the electrotome.

It is technically only slightly more complicated, but in practical usage of considerable advantage to provide the sheath with its own drainage port. This should be of wide caliber and be able to accept a run-off tube, through which both irrigating fluid and resection chips may drain after the electrotome is removed. If the open end of the sheath is closed with one finger, extensive soiling of the operating theater and operator may be largely avoided (see Fig. 100).

The long run-off tube generates a mild siphon effect which hastens emptying of the bladder. We use a tube of approximately 40 cm length which drains into the operating table funnel. The sterile drape is provided with a plastic gauze window which sieves out the resected chips.

Where such equipment is lacking the drain may be run to a bucket and connected to the inlet stub of a collecting sieve. Such a drainage arrangement, with its greater length of hose, will generate an increased siphon effect (Fig. 15).

A degree of perfection of the resectoscope sheath was achieved with the introduction of the central irrigation cock. This is a three-way cock controlling water inlet and drainage. The advantages of this system are discussed in detail in Chapter. D.III.3.e).

A resectoscope with central stopcock has for many years been our standard instrument.

γ) The Obturator. The obturator closes the vesical end of the sheath and aids instrumentation (Fig. 16). Three basic types are available:

1. Viewing obturators
2. Straight obturators
3. Timberlake obturator according to hinged

The Viewing Obturator. Not infrequently it is useful to introduce the sheath under direct vision. This is greatly facilitated by the use of a viewing obturator, which allows atraumatic instrumentation under direct visual control. By the combined use of direct vision and simultaneous irrigation urethral trauma is avoided.

The Straight Obturator. This is the most frequently used type of obturator. A particularly useful variant was introduced by LEUSCH. Locking the obturator causes a rubber cuff to spread and bulge against the sheath aperture, thus shrouding its sharp edges. This mechanism reliably protects the urethra from this form of trauma.

The Hinged Obturator. This finds ready application when blind instrumentation is thwarted by the marked ventral protrusion of a large middle lobe obstructing advancement of the sheath. I have no personal experience with this type of obturator, since I prefer instrumentation under direct vision using the forward-

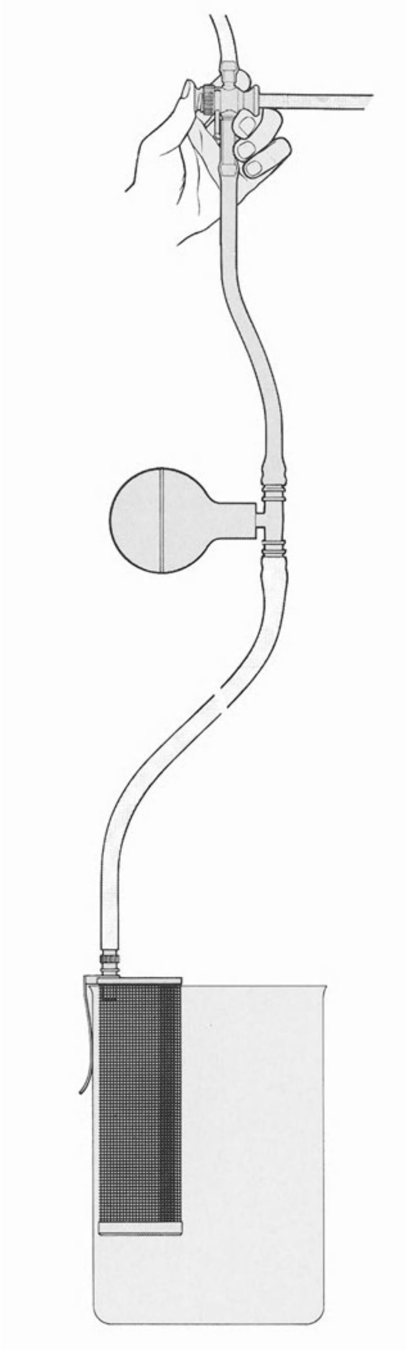
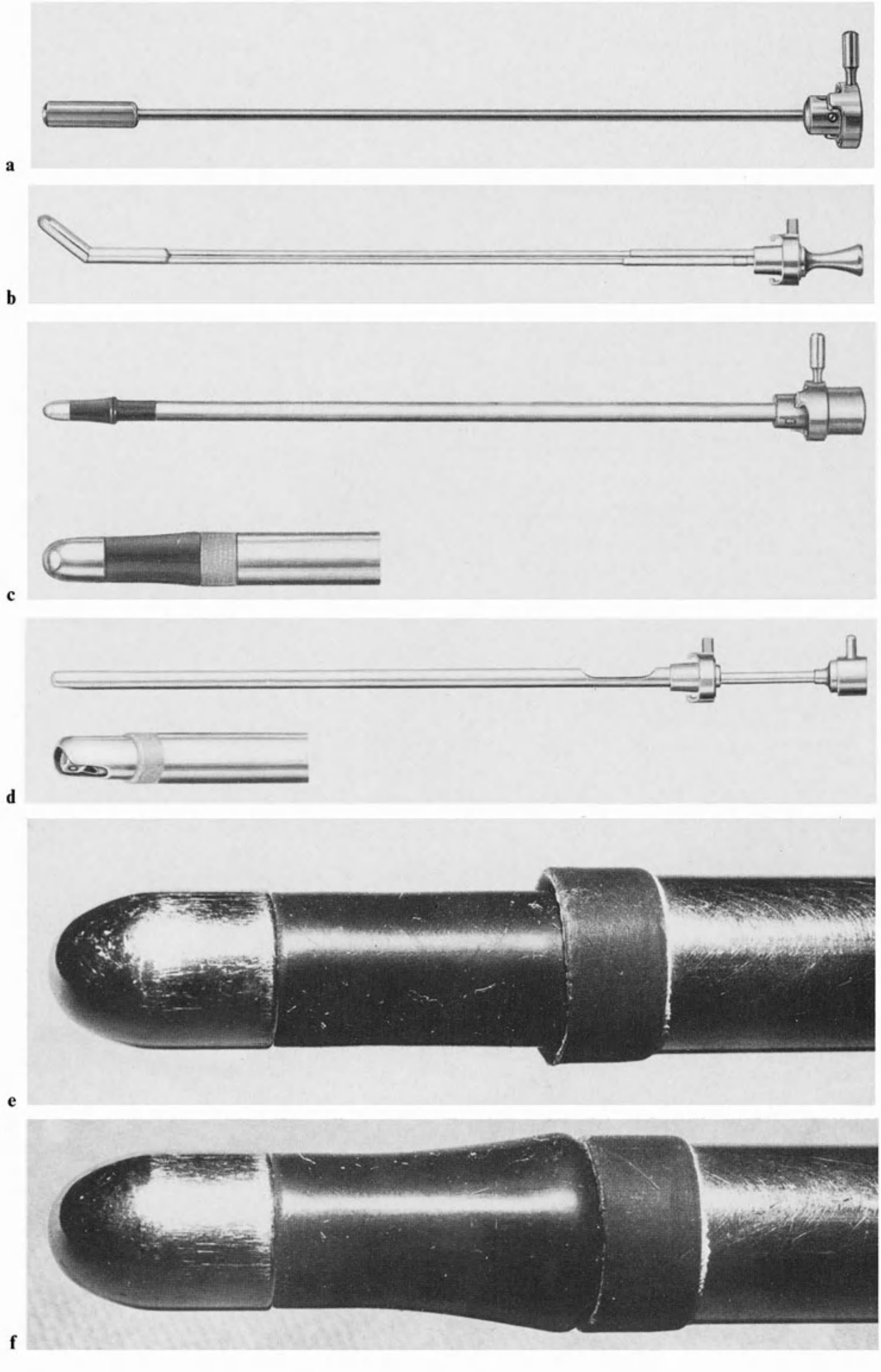


Fig. 15. Drainage of irrigation fluid by outlet port and central cock. In the example shown here a rubber bulb (Ellik-pattern) forms an integral part of the drain pathway, thus allowing better extraction of resection chips. The latter are collected by a sieve hooked over the side of a 10-liter collecting bucket. Graduations on this bucket aid in the estimation of blood loss


a
b
c
d
e
f

viewing telescope of the electrotome. Under direct vision it is always possible to surmount the obstacle of a ventrally protruding middle lobe.

b) The Electrotome

The electrotome is an operating unit consisting of telescope and cutting loop control mechanism.

α) Loop Control Mechanisms. Three distinct systems of loop control are in use (Figs. 17 and 18):

1. Rack and pinion loop control as in the original Stern-McCarthy instrument
2. The Nesbit system
3. The Baumrucker system

The rack and pinion mechanism is certainly the one offering most accurate control of the loop. However, its use requires longer practice.

In the Nesbit system a spring retracts the cutting loop into the sheath. Cutting therefore requires that the loop be extended out of the sheath by pressure against the spring, and the loop will then retract of its own accord. The operator achieves faster or slower cutting by varying his resistance to the spring return.

In the Baumrucker system a spring extends the loop out of the sheath, and cutting is achieved against the tension of this spring by manual retraction of the loop into the sheath. The loop is thus extended out of the sheath in the resting position and this must be borne in mind when introducing such electrotomes (Fig. 18c).

In the final analysis the choice of loop mechanism will depend on the operator's training, temperament and personal preference.

The electrotome has a viewing channel for interchangeable telescopes, and the cutting loop is firmly fixed to its transport mechanism. This also bears a connecting terminal for cutting current.

A large number of variations on this basic principle are commercially available. In drawing attention to the specifications found in instrument catalogues, I would emphasize that the art of operating ultimately depends on the dexterity of the operator, which the most artfully designed mechanism can never replace. It has been my observation that the majority of experienced transurethral operators use the simplest possible instruments, while the self-taught and beginners seem to prefer mechanically more complicated models, in the apparent hope of compensating for their lack of experience by the refined construction of their instrument (NESBIT 1943).

The cutting loop must be firmly connected to the live lead, ideally by screw connections.

◁ **Fig. 16a–f. Obturators for occluding the vesical end of the sheath. a** Simple metal obturator without protection of the insulating ring. **b** Timberlake hinged obturator. **c** LEUSCH obturator. In the closed state a rubber sleeve protects the sheath aperture, thus preventing urethral injury. **d** Viewing obturator according to SCHMIEDT, with telescope in situ. **e**, **f** Detailed view of LEUSCH obturator in open (**e**) and closed (**f**) positions

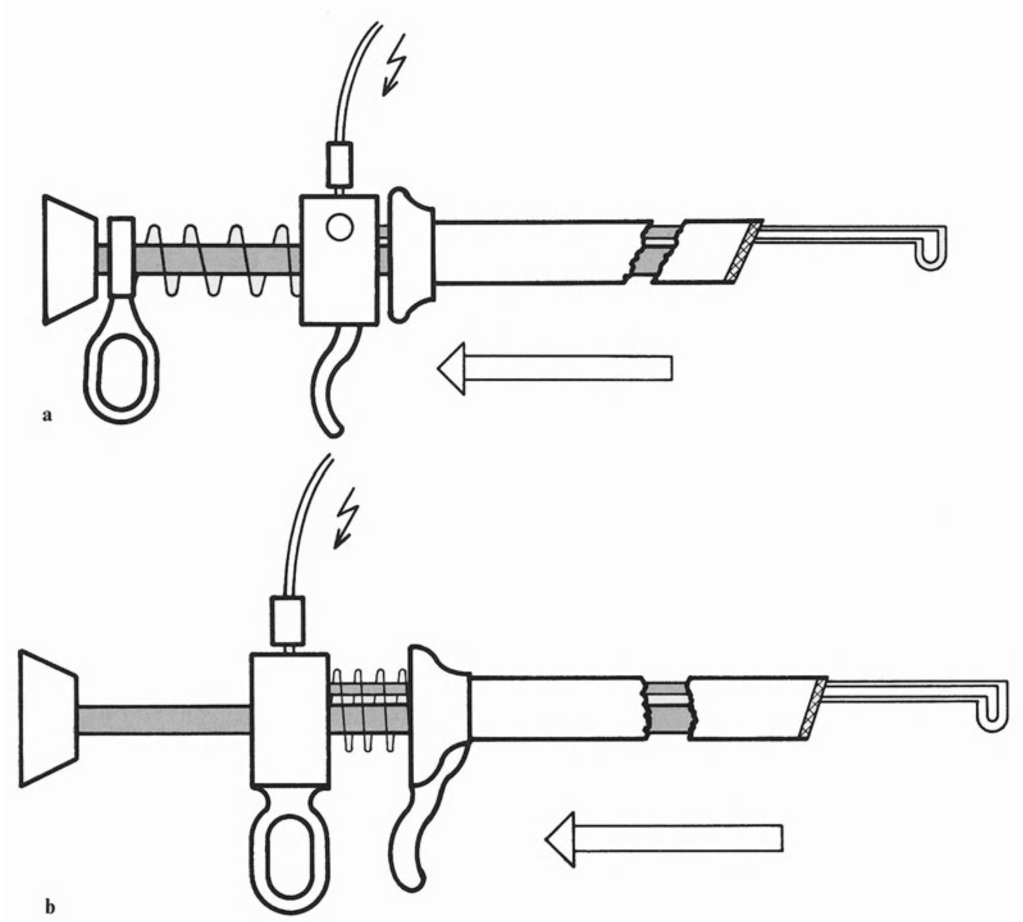


Fig. 17a, b. Diagram of two types of loop control mechanism. a Baumrucker system for cutting by digital pressure. A spring between telescope and loop carriage extends the loop from the telescope. Cutting is achieved by pulling a lever back toward the eyepiece. This compresses its spring which will return the loop to its starting position at the end of each cut. **b** Nesbit spring-powered system for passive cutting. Extending the loop compresses a spring which will retract the loop when the lever is released

The loop control mechanism should be checked for freedom of travel before any operative maneuver.

β) Cutting Loops and Other Work Pieces. The tissue is normally cut by means of a loop-shaped electrode, this loop being made of fine tungsten wire. Depending on application, the gauge of this wire varies between 0.35 and 0.25 mm (0.01–0.014″). Finer loops require less current to cut the tissue, but they are mechanically less robust. Since the cutting loop is gradually eroded by the current, its central portion, which most frequently enters the tissue, is consumed more rapidly than the lateral sections (Fig. 19). The latter are prone to little

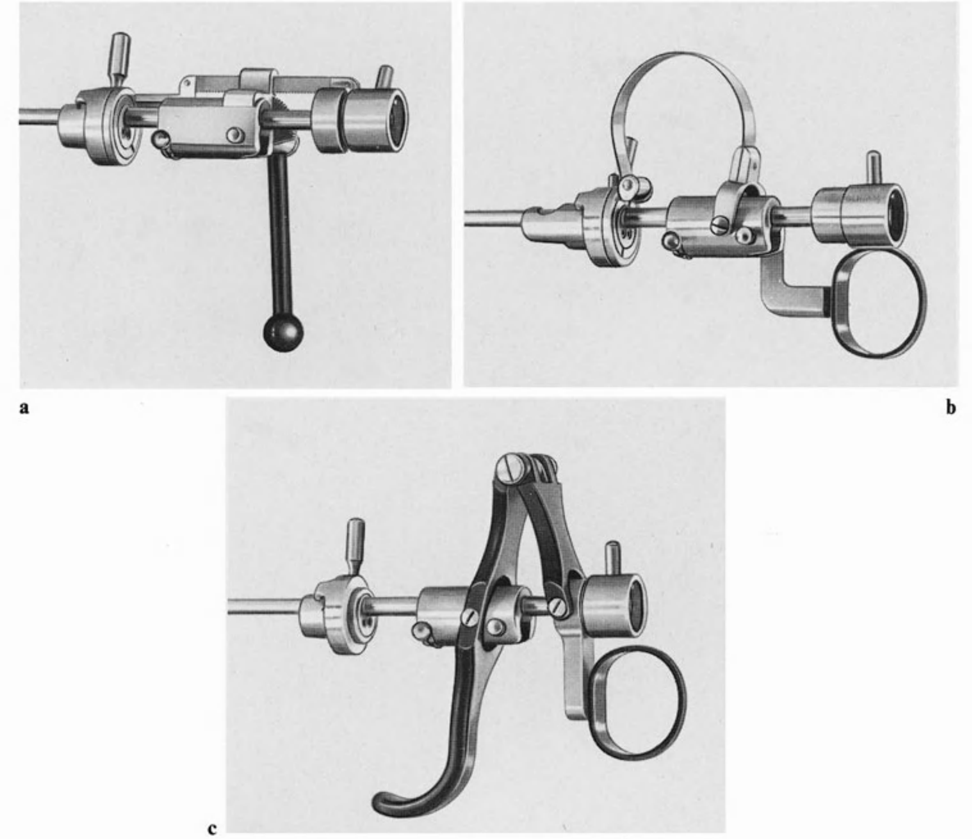


Fig. 18a–c. 3 patterns of loop control mechanism. a Rack and pinion system. Back and forth movements of the lever retract and extend the cutting loop. This mechanism corresponds to the Stern-McCarthy system (carriage for loop attachment and high frequency connection). **b** Spring-powered cutting arrangement. The bent leaf spring (Iglesias pattern) retracts the loop into the sheath. This spring must therefore be compressed every time the loop is extended into its cutting position. **c** Cutting by finger pressure. A spring built into the lever system extends the cutting loop out of the sheath. Active pressure is therefore required to retract it during cutting. Note that with this system the loop is extended in the resting position

deterioration and may advantageously be used for the coagulation of bleeding points, which requires the largest possible contact area.

The progressive consumption of the cutting loop may be observed endoscopically.

Figure 20 gives a review of the available cutting loops and other work pieces. Tumors in certain parts of the bladder are advantageously dealt with by the straight mowing loop, but its use demands great perfection of operative technique. This loop projects from the sheath even when the instrument is fully retracted (see Chap. G).

The resection of bladder tumors requires thin loops, since only these permit fine dissection with low currents. In view of the small quantity of tissue usually

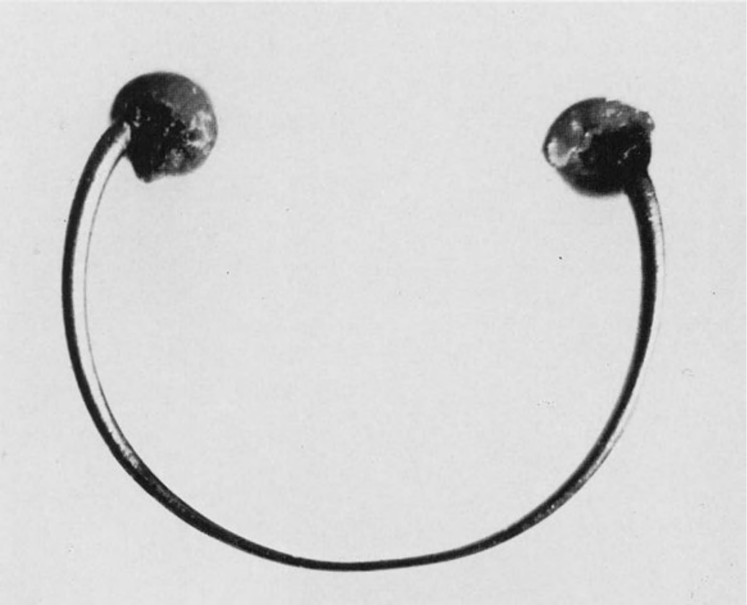


Fig. 19. Markedly worn cutting loop. The loop shows most wear at the point of maximum use. The high current density generated by such a narrow cross section is particularly suitable for the resection of bladder tumors. Smooth sharp cuts may be achieved at low current settings. Coagulation, however, should be carried out using the side flanks of the loop, where there is a greater area of contact to prevent the loop sinking into the tissues in a cutting fashion when coagulation current is applied

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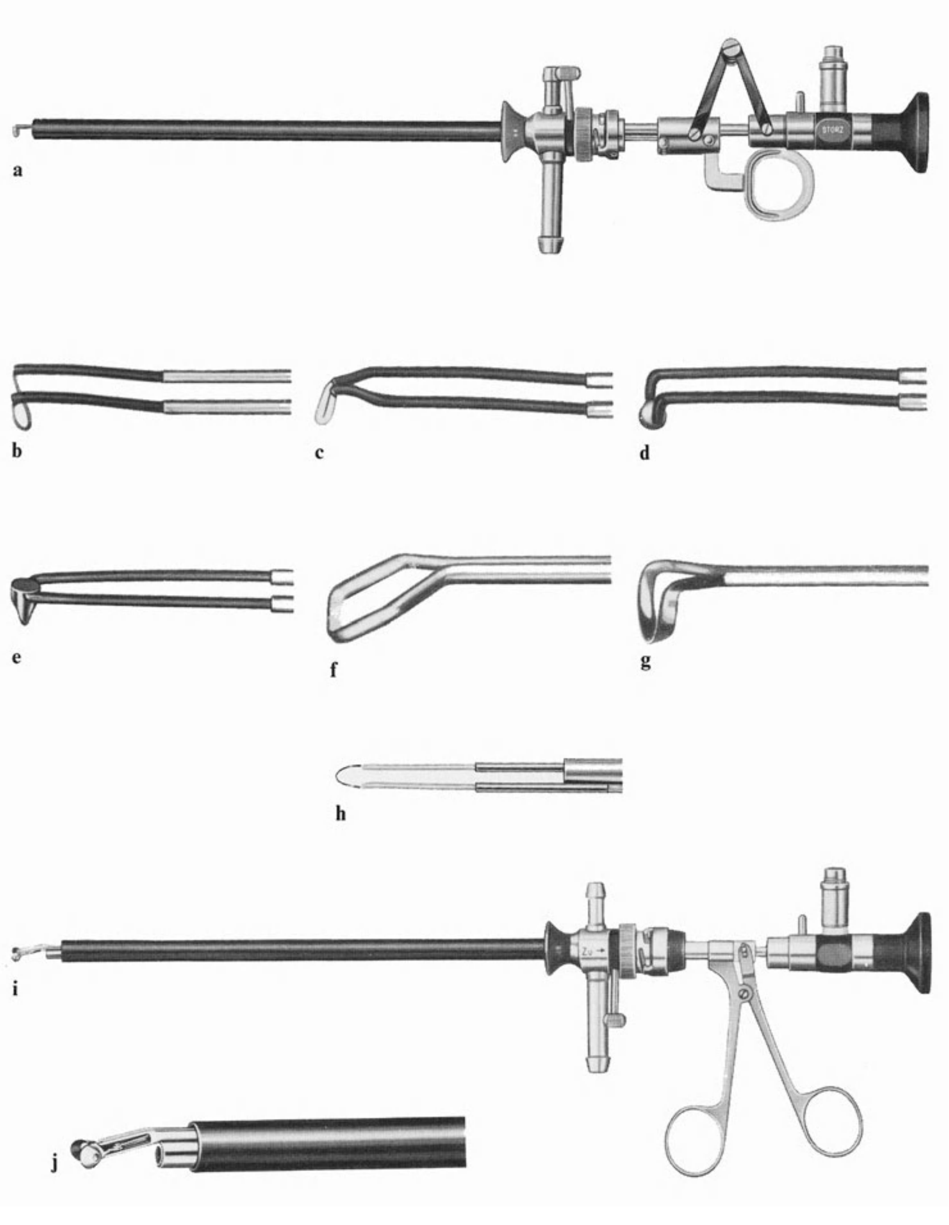
Fig. 20a–j. Resectoscope according to Mauermayer. a General view with electrotome inserted. Important features of the instrument include the central cock and drainage stub and a telescope set rather more distally than usual in the sheath. The telescope is thus placed at the point of best irrigation and allows a high quality view even in the presence of brisk hemorrhage. The telescope is set centrally within the sheath, being of pure forward-viewing type without a deflection prism (0° system). The advantages of this system are discussed in detail in the text. **b** Standard cutting loop. **c** Knife-shaped electrode for cutting bands of scar tissue and for sphincterotomy in neurogenic outflow disturbances. **d** Ball electrode for surface coagulation of wide area, e.g., hemorrhage from inoperable tumors. **e** Conical electrode giving point coagulation for hemostatic control of persistently bleeding vessels by generating a high density current at the electrode tip. **f** Blunt curet for scraping off necrotic tissue and encrustations in the bladder and prostatic capsule. **g** Sharp curet for removing more firmly attached slough and for drawing calculous debris into the sheath. **h** Mowing loop. This type of loop is particularly suitable for resecting bladder tumors on the posterior wall. Because its use may easily lead to perforation of the bladder it should be restricted to the most experienced operators. **i** Rigid biopsy forceps. This is rendered more versatile by the arrangement for its extension and retraction within the sheath. **j** Detailed view of these forceps. Note the gouge pattern of the jaws, which is designed to provide sharp separation of the tissue margins and therefore reduced trauma artefact in the specimen

▷

to be removed, the more rapid wear of these loops is of no significance, whereas surgery to a prostatic adenoma demands the almost exclusive use of thicker loops so as to avoid changes of loop during the operation.

A number of manufacturers offer rigid loops designed to be used without current in the fashion of a curet for the clearance of necrotic tissue and adherent coagula from the operating field. They are also useful for the clearance of calculous material following litholapaxy.



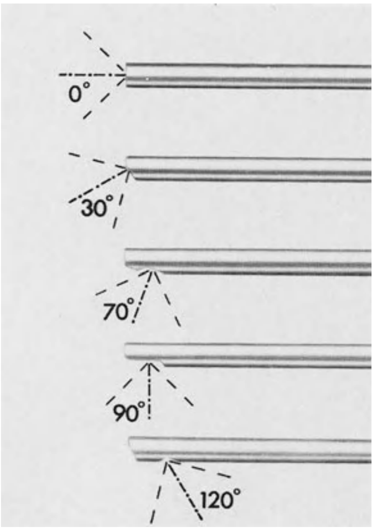


Fig. 21. Viewing angle of the various telescopes used in our practice (Hopkins, Storz). The chain-dotted line represents the optical axis and the broken lines the field of view

A cutting hook is a useful instrument for incising the bladder neck. It may be equally employed for dividing a fibrosed internal sphincter in the female and in neurogenic outflow disturbances in the male.

Various patterns of coagulating probe are available, and the electrode is generally so designed as to provide a wide area of coagulation. Ball electrodes are also available for rolling across the operating field. Such electrodes should be used with great caution, since coagulation over an excessively wide area leads to unnecessary necrosis. The principle indication for their use is diffuse parenchymal bleeding in which individual bleeding points cannot be located.

γ) The Telescope. As a general rule, optical systems for transurethral surgery have a more or less forward-viewing axis (Fig. 21). For historical reasons it has been traditional to use telescopes with 3–5° angulation of the viewing axis. This arose mainly from technical requirements for illumination of the operating field prior to the introduction of fiber optics. However, modern fiber optic technology has enabled the construction of purely forward-viewing resection telescopes. I personally prefer 0° telescopes in which there is no angulation of the viewing axis.

c) Irrigation Fluids for Transurethral Surgery

Irrigating fluid for transurethral operations may be prepared in one of two basic fashions:

1. A continuous supply by means of factory-built filtration or reverse osmosis plant with automatic refilling of the reservoir and addition of concentrated additives to preserve isotonicity.

2. Prepacked, ready-prepared irrigation solutions in bags or containers.

Because any transurethral resection of the prostate carries the risk of intravenous passage of irrigation fluid, only isotonic solutions should be used. Although irrigating fluid is in no way a therapeutic agent designed for intravenous injection, any resection will entail lesser or greater quantities entering the venous system, and there is thus a strict requirement for pyrogen-free water.

It is not yet clear whether the application of newer reverse osmosis or anodic oxidization plant will prove to be economical and safe. It may well be that the use of prepacked irrigation fluids will become the standard method. At present the latter is rather too costly for general application.

d) The Fiber Optic Light Source

All makers of endoscopic instruments supply light sources which are particularly suitable for their own fiber optic light cables. Ideally, a combined high frequency diathermy and light source are suspended by a ceiling bracket.

e) The High Frequency Diathermy Unit

High frequency current generators with special settings for cutting and coagulation are now in general use. A footswitch selects cutting or coagulation current according to requirements. Although a previous generation of machines employed a vacuum tube system for cutting and a spark gap generator for coagulation current, virtually all manufacturers nowadays supply exclusively solid-state equipment generating both types of current. An indifferent electrode provides a large surface area of contact with the patient, either by means of a buttock pad or a foil plate wrapped around the thigh, according to local preference. The most important problems of high frequency surgery, the appropriate safety rules and basic principles of high frequency technology are discussed in Sect. III.

f) Lubricating Agents

Until recently, little attention was paid to the lubricating agents used to reduce friction between the urethra and the resectoscope sheath.

Following the studies of FLACHENECKER et al. (1977, 1979) we have come to realize the importance of using electrically conducting lubricants with metal sheaths so that an electrically conducting film is formed between the sheath and the urethral mucosa (see Sect. III). Teflon sheaths require special lubricating agents able to coat this water-repellent material.

Before introducing the sheath we gently (i.e., without exerting pressure) fill the urethra with lubricant by means of a 10-ml glass syringe (gonorrhea syringe). The carefully lubricated sheath can then be introduced more smoothly.

g) Sundries: Lighting Cable, High Frequency Cable, Irrigation Supply, and Drainage Hoses

Individual instrument companies so design their light cables that they will only fit their own instruments. However, by means of adaptors or by unscrewing part of the connection, they may be adapted for other types of instrument (Fig. 22).

These light cables contain varying numbers of individual glass fibers (Figs. 23 and 24). It is generally recommended to use the thickest available cable, since its superior light-conducting power will provide the best illumination of the bladder. Although our modern high-power optical systems provide a considerably better picture than did the old pre-Hopkins lens systems, one should nevertheless always aim to work in a field of maximum brightness, as provided by the thickest available cable. There is then no difficulty in undertaking cysto-

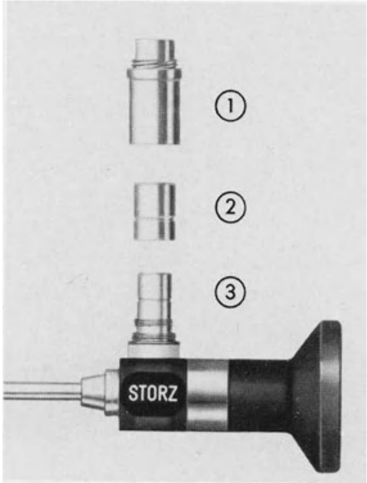


Fig. 22. Universal light connector. By screwing on a variety of threaded sleeves the telescope ③ may be connected to various manufacturers' light cables (①, ② = threaded sleeves)

Fig. 23a, b. Fiberoptic cables of various caliber, view across the end of the fiber bundle. a Standard cable with modest number of fibers. Such a cable is suitable for the majority of all diagnostic and therapeutic maneuvers. **b** Diameter of a cable of high total fiber cross section. This type of cable is used mainly for photographic and cine application or for use with prismatic or fiberoptic teaching attachments (the latter always divert a proportion of the available light to the observer through a beam splitter)

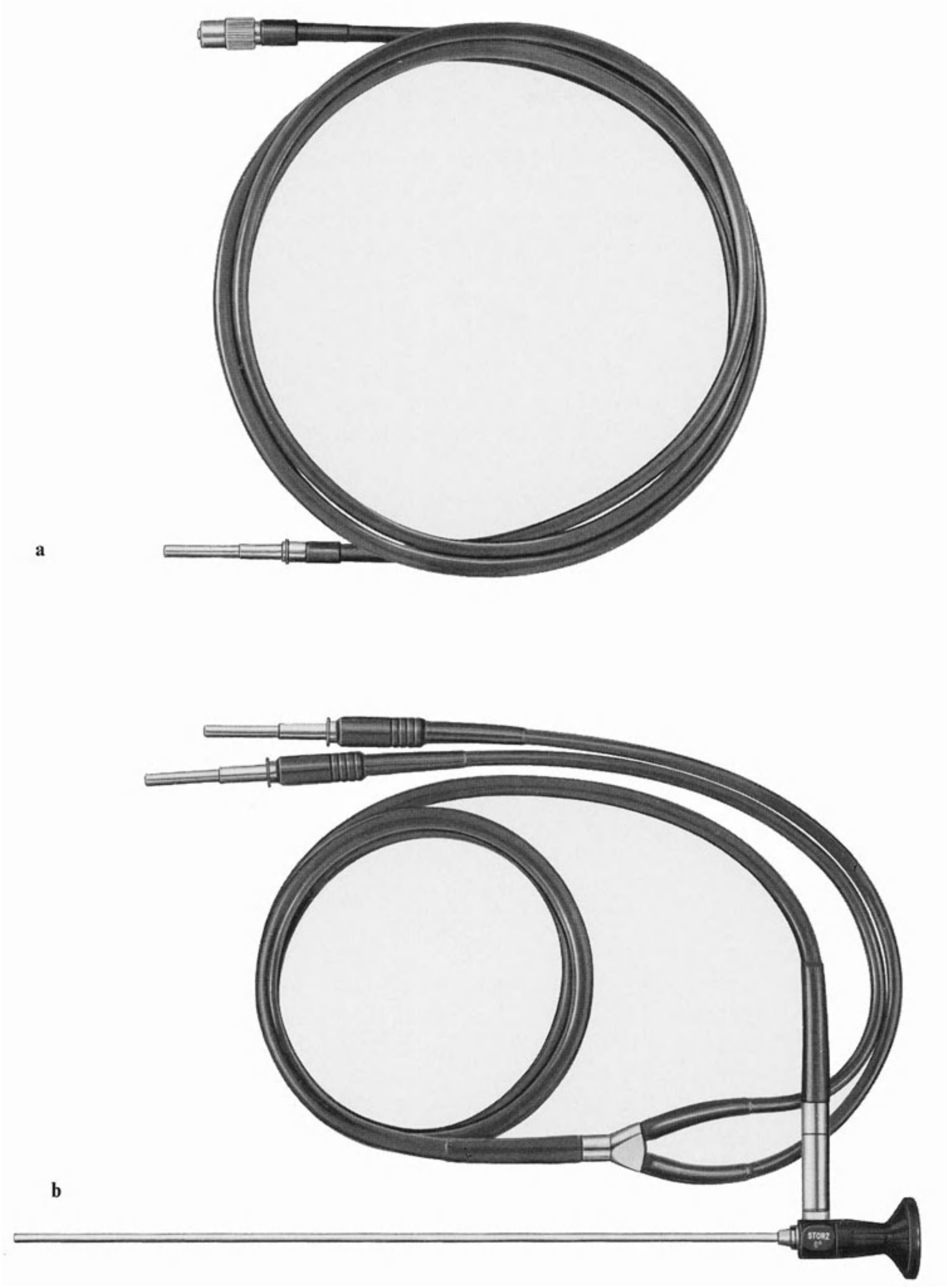


Fig. 24a, b. Light cables for diagnostic and therapeutic applications. a Standard cable with a cross section corresponding to that in Fig. 23a. **b** Integral system. Light is taken from the lighting unit at two separate points and subsequently united in a single fiber bundle which runs without interruption to the vesical end of the telescope. Optical systems of this type generally have special applications, such as video, cinematography and still photography, all of which have high light requirements scopy or resection using a normal light source equipped with a 150-W or 250-W halogen tube. However, the attachment of fiber optic or prismatic teaching attachments to the eyepiece may well divert too great a quantity of light to the observer, so that the operator's image becomes too dark. Under these circumstances, it is advisable to use a light source employing a high-pressure mercury vapor tube, which most manufacturers supply for this very purpose. It may then also be helpful to use a light guide with twin connecting plugs. For video- or cine-recording of endoscopic procedures so-called integrated light systems (Fig. 24b) are advantageous, since the individual fibers run without interruption to the front lens of the telescope.

High frequency leads connect the cutting loop or coagulating probe to the high frequency diathermy. They are specially designed for compatibility with the terminal on individual instruments and are therefore not generally interchangeable, except in the case of coagulating probes, for which a standardized pattern of connector has gained ground.

Silicone rubber hosing has become popular for the irrigating system. This material is transparent, allowing one to detect air bubbles and the presence or absence of flow in the tube. They are relatively resilient and not easily kinked. The size required will depend on the size of connector on the instrument. Their length should always be adequate to allow the operator free movement to the maximum excursion of his instrument.

Run-off hoses are only required for instruments having a drain port on the sheath. Since this drainage port is generally of larger diameter than the inlet, appropriate sizes of tubing will be required.

The length of tubing will need to be adapted to the sieving system employed, be it part of the sterile drape or a drainage sieve in the floor bucket.

The short drain hose employed in the sieve-drape system is generally packed as part of a sterile drape set. Its free end is attached to a special anchor piece which keeps the outlet clear of obstruction and prevents its direct contact with the drapes.

If irrigation fluid is to drain into a floor bucket, additional length is required in the drain hose to provide free movement. The hose is usually connected to an attachment on a sieve, allowing the collection of resection chips.

For the recovery of individual separate tissue samples, for example during the resection of bladder tumors, we use a sterilizable sieve which is positioned in the collecting funnel of the operating table and emptied at the end of each collection cycle by tapping it out on a sterile towel.

5. Lithotrites

a) Preliminary Considerations

Blind litholapaxy is a dying art practiced ever less frequently since the availability of alternative technology has saved a whole generation of young urologists from having to learn this technique. Litholapaxy by electrohydraulic pressure waves and by ultrasound has, furthermore, displaced purely mechanical methods, although I personally would greatly regret the demise of the blind lithotrite.

Since the introduction of the punch lithotrite (MAUERMAYER 1976) a new technique of litholapaxy has come into being.

b) The Punch Lithotrite According to Mauermayer

This instrument crushes the stone by the application of the same principle as that employed in the punch resectoscope (YOUNG). Naturally, its mechanical construction needs to be adapted to this use.

The instrument consists of a metal sheath equipped with a central stopcock as previously described, an obturator, a hand-lever system for operating the crusher and a telescope (0° and 30° systems available according to preference) (Fig. 25).

α) The Sheath. The sheath is an elliptic metal tube of 24 Ch. Its vesical end is so designed as to withstand considerable mechanical stress. The external end is equipped with the three-way central stopcock as described. The sheath is provided with an obturator to close it off during introduction.

β) The Operating Module. The operating module consists of a second tube of high tensile steel which can be withdrawn into the sheath by a scissor-grip mechanism. The vesical end of the punch tube is so notched out as to fashion a small point directed backward toward the internal meatus. The calculus or its fragments are maneuvered into this notch of the inner tube, and closing of the handgrips crushes it in a resection-like maneuver.

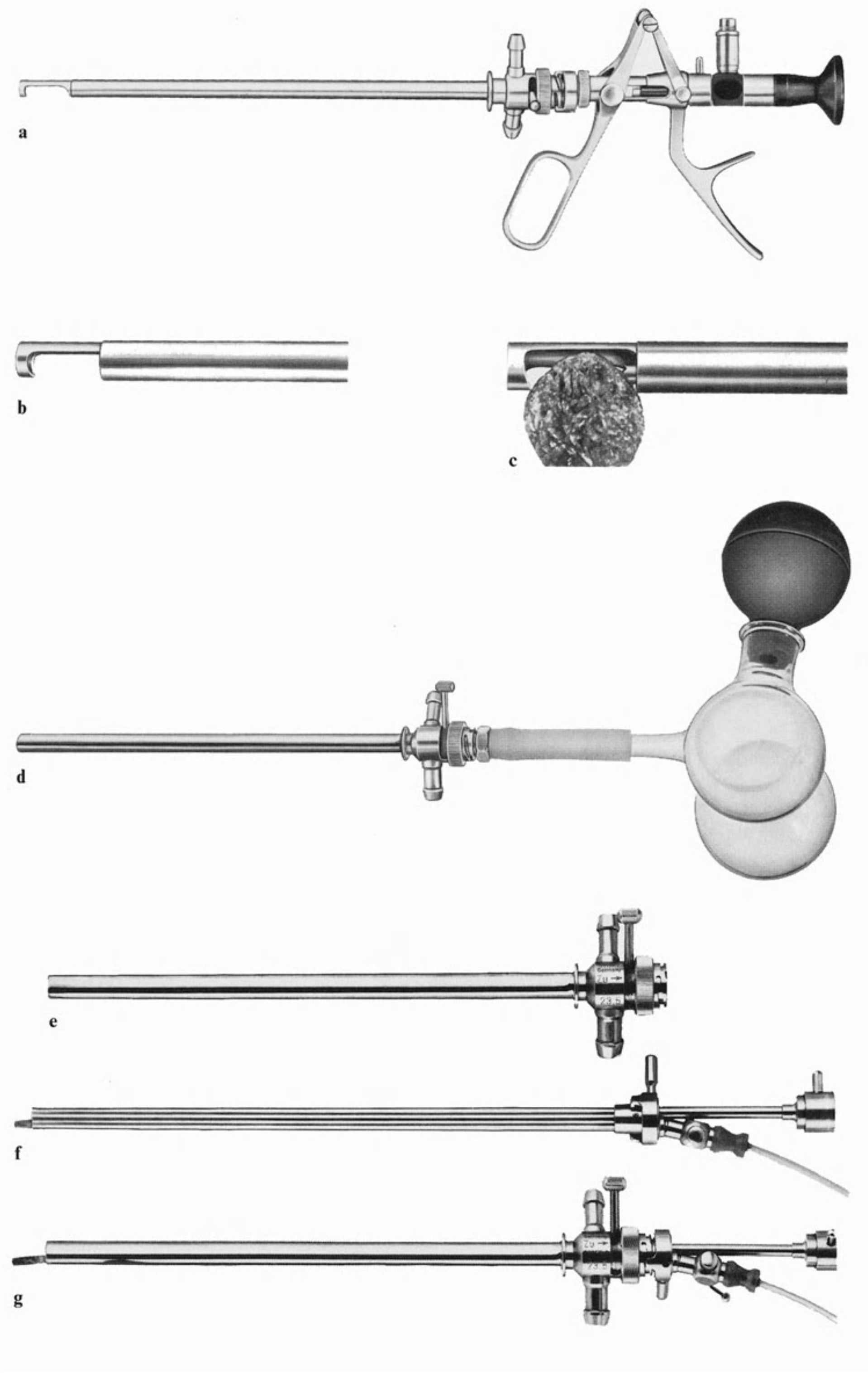
It is of paramount importance that the inner section be introduced into the sheath with the grips in the closed position, since lack of such control may lead to serious injuries to the bladder. The grip should only be released under direct vision.

The inner tube contains a telescope channel.

Instead of this punch forceps, a sheath insert may be used which consists of a control mechanism for an electro-hydraulic lithotrite probe. An ultrasound lithotrite by the same maker (Storz) may also be introduced into this sheath.

In its present form, the punch lithotrite is capable of endoscopic removal of virtually any calculus, with the exception of those whose great mechanical strength renders them equally immune to electrohydraulic litholapaxy. We have had no experience of such resistant concretions when using the ultrasonic lithotrite. In our practice the Ellik evacuator has proved invaluable for the removal of debris. Alternatively, the rubber bulb that we employ in the run-off tube during resection procedures may be of equal use.

We have completely given up using Young's stone-crushing forceps or larger mechanical viewing lithotrites.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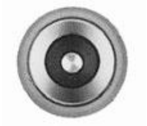

Fig. 26. Frontal view of probe for use with the Urat apparatus. In the center may be seen the core of the high tension coaxial cable surrounded by a dark insulating ring. This is coaxially surrounded by the tubular second electrode, which in turn is protected on the exterior by an insulating sheath. Spark discharge between the central and ring electrodes gives rise to pressure waves which shatter the calculus

c) The Urat-I-Lithotrite

The instrument consists chiefly of a generator providing short bursts of high tension electricity. This is discharged as a spark by means of a special probe brought into contact with the calculus. The probe has a diameter of 10 Ch and consists of an inner central conductor separated by an insulating layer from a coaxial outer tube (Fig. 26).

When the current is switched on, sparks are discharged between the two electrodes.

If the probe is brought into close contact with a calculus, the latter will be shattered by shock waves resulting from the spark discharge. This apparatus should only be used under most careful adherence to the operating instructions, with particular attention to grounding of the apparatus, the patient and the operating table. I have used this instrument for almost 20 years and have never experienced an accident.

By this method litholapaxy may be undertaken through virtually any instrument with a suitable 10 Ch instrumentation channel.

d) The Ultrasonic Lithotrite

Although extremely elegant in principle, this technique was at first bedeviled by technical problems with the apparatus, so that it did not initially gain ground as rapidly as it deserved to. The problems, which were principally concerned with the generation of high frequency waves, are now solved and technically

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◁ **Fig. 25a–g. Mauermayer punch lithotrite. a** General view of the instrument with the operating unit in position. **b** View of the vesical end, explaining the mechanism of action. Compression of the handgrip retracts the inner tube into the sheath. **c** A calculus grasped by the instrument, thus further demonstrating the mode of action. **d** Stone punch sheath with attached Ellik evacuator. In place of a directly attached evacuator (illustrated), a rubber bulb along the course of the drain hose (see Fig. 15) may also be used for aspirating debris. **e** Punch sheath without operating unit. **f** Operating unit with Urat probe in situ. The operating channel is of 10 Ch diameter. **g** Urat operating unit inserted in the punch sheath. Such a combination allows a preliminary attack on a large calculus, followed by its definitive destruction by the punch unit

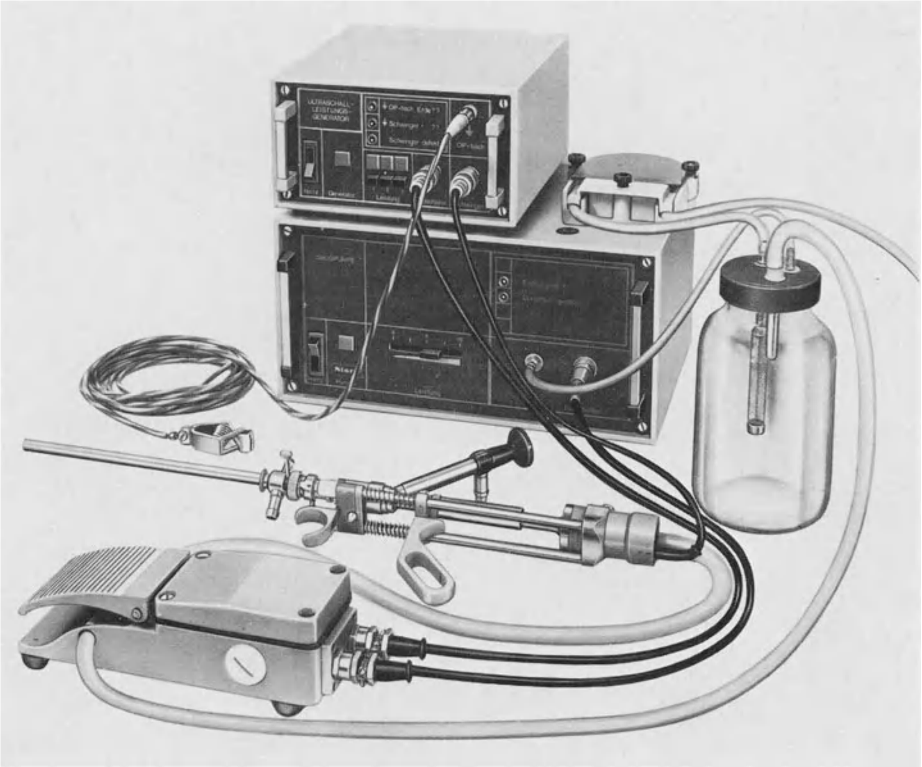

Fig. 27. General view of an ultrasound lithotrite (Aachen model). The operating unit of the lithotrite is seen inserted in the punch lithotrite sheath. A cranked telescope enables in-line attachment of the ultrasound drill probe. In the background is seen **above** the ultrasound generator, and **below** an irrigation unit with its peristaltic pump. A foot switch controls both generator and irrigating unit. The irrigator also provides for cooling of the ultrasound transducer (quartz crystal). In addition to the connecting leads shown here, inlet and drain hoses are required for the punch sheath. Despite the profusion of cables and hose connections one may work quite rapidly with this instrument, since no change of position is needed

mature production models of this apparatus are available. Its mechanism of action is based on the technical principle of all ultrasound apparatus: a quartz crystal is excited by an electromagnetic signal and emits synchronous oscillations. The forward and backward excursions of the crystal are coupled to the operating element of the lithotrite, the tip of which is armed with a crenellated drill tip. Thus an ultrasonic lithotrite set consists of the following individual components (see Figs. 27 and 28):

1. The ultrasound generator. This generates the high frequency electromagnetic signals for escitation of the crystal.
2. The lithotrite itself. A metal housing contains the active quartz crystal which is coupled to a connecting rod running down the instrument sheath into the bladder as the operating element.
3. A water connection is provided for cooling of the quartz crystal.

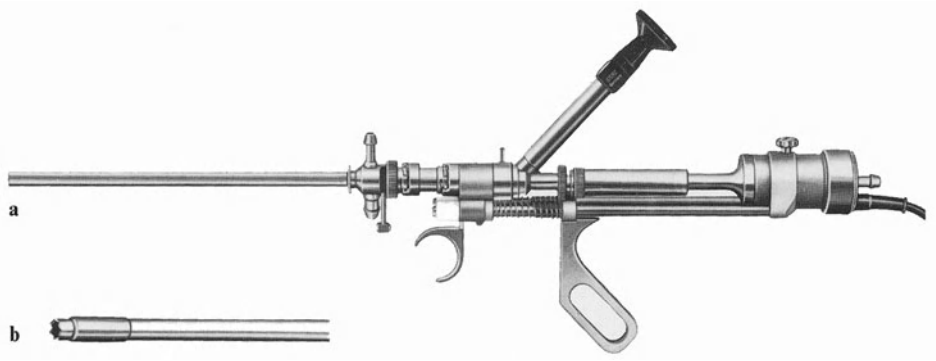

Fig. 28a, b. Detailed view of ultrasound unit inserted in the punch sheath. **a** Note the cranked telescope and the ultrasonic transducer head with its cooling water and high frequency cable connectors. Irrigation inlet and drain hoses remain to be connected to the punch sheath and are under the control of a central cock. **b** Detailed view of the ultrasound drill tip

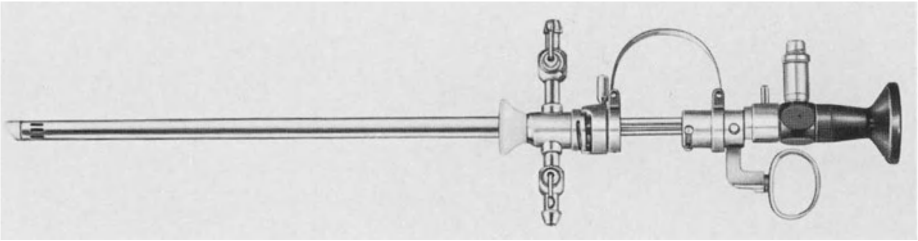

Fig. 29. Iglesias resectoscope. Inlet slits for continuous drainage of irrigation fluid may be seen at the vesical end of the instrument (see text)

The particular ultrasound lithotrite which we use is so far perfected that the comminution and evacuation of bladder calculi no longer present difficulties and may generally be accomplished without general or spinal anesthesia. The only disadvantage of the technique is that the stone is not shattered into fragments but has to be rather laboriously drilled apart.

6. The Continuous Irrigation Resectoscope

This instrument was first described by IGLESIAS in 1975. It enables resection to be undertaken as a continuous, uninterrupted process. Fresh irrigating fluid, so essential for the maintenance of a clear view, is continuously supplied to the resection field and is equally continuously evacuated under negative pressure through small fenestrations in the vesical end of the sheath (Fig. 29). Such continuous irrigation resectoscopes are nowadays available from all major instrument makers. Precise descriptions of the individual instruments may be found in the manufacturers' catalogues and in special publications.

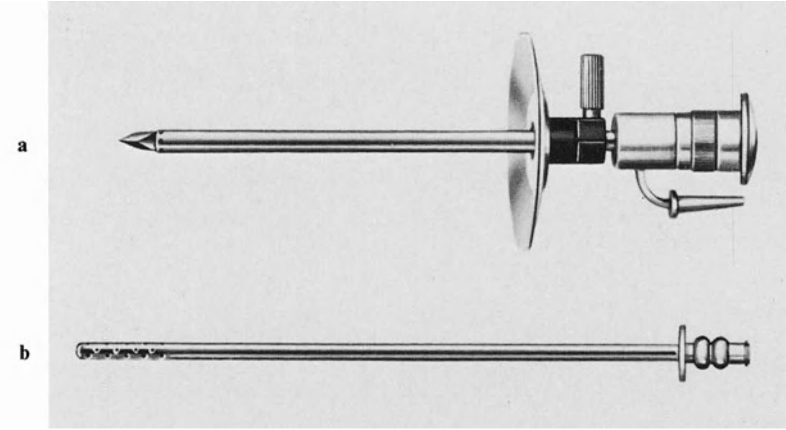

Fig. 30a, b. Reuter trocar for suprapubic puncture of the bladder. **a** Trocar and stylet for penetration of the abdominal wall. **b** The trocar inset with multiple holes for collection of irrigation fluid. Penetration depth of the trocar may be controlled by the adjustable collar and plate

The chief objective behind the design of this instrument is prevention of excess hydrostatic pressure in the bladder and prostatic cavity, with the aim of avoiding the infusion of irrigating fluid into the prostatic capsular venous plexus.

7. The Suprapubic Aspiration Trocar

Reuter and Jones (1974) described a special trocar which also permits continuous drainage of irrigating fluid from the bladder during transurethral resection. At the beginning the operation the trocar is inserted transcutaneously into the well-filled bladder. The operation then proceeds in the usual fashion using an ordinary resectoscope. Irrigation fluid is continually aspirated via the trocar connected to a suction device. This technique has the same aim as the above i.e., minimizing irrigation fluid infusion via opened prostatic veins (Fig. 30).

8. The Laser Operating Cystoscope

The laser operating cystoscope is a special cystoscope of approximately 25 Ch diameter, designed or laser coagulation and permitting the transmission of a laser beam. Following the initial theoretical and practical studies by Müssigang, Hofstetter, Schmiedt in 1980 (see Hofstetter et al. 1979) we have, ourselves, recently started to employ the technique of laser coagulation (Neodyn-Yaklaser by Messerschmidt–Bölkow–Blohm).

Although laser operating cystoscopes are at present available from two companies, they are of essentially similar construction (Fig. 31). The laser-generated

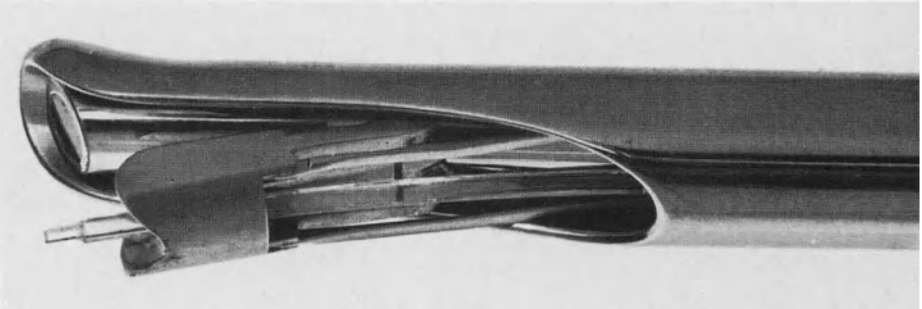

Fig. 31. Vesical end of the laser-operating cystoscope. The exit point of the laser beam may be seen on the movable lever. Note the laser conduction bundle within the sheath aperture. The beam is thus controlled both by the Albarran lever and by movement of the entire instrument

light passes via a firm screw connection to the operating element of the cystoscope. A quartz conductor carries laser light down the interior of the instrument and terminates as an integral part of the Albarran lever, which thus renders it dirigible. Since the laser beam of this apparatus is not itself visible, it is marked by a red pilot beam so as to facilitate the operator's control of the beam.

9. The Operating Urethroscope

Diagnostic urethroscopes belong to an early historical phase of endoscopy. As well as permitting the passage of a ureteric catheter for marking out and dilating tight strictures, the original instrument described by FISCHER was provided with an additional channel allowing the passage of a fine insulated wire probe with which internal urethrotomy could be carried out by high frequency diathermy.

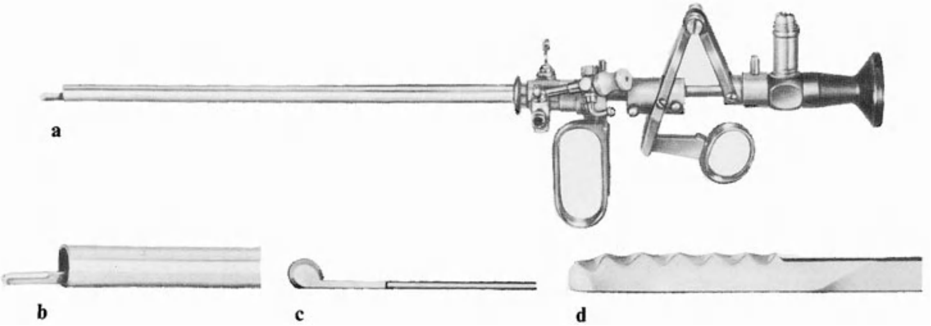

Fig. 32a–d. Sachse operating urethroscope for cold incision of urethral strictures. a The instrument fully assembled. The knife is so adjusted as to partly protrude from the sheath when extended. The sheath itself is equipped with a channel for the passage of a filiform bougie. **b** Detailed view of straight knife in sheath aperture. **c** Angled disk-shaped knife. A bend in the control rod moves the blade to the lateral edge of the field of view, thus facilitating anatomical orientation. **d** saw-toothed blade (enlarged)

In 1973 SACHSE published a description of the viewing urethrotome which bears his name and he thus initiated a renaissance of internal urethrotomy (Fig. 32).

The urethrotome has a 20-Ch metal sheath which is able to accept an operating element imparting cutting ("sawing") movements to a small knife for which various types of blade are available. In the modification of DETTMAR a small loop on the bellied knife may be threaded over a ureteric catheter which controls the direction of cut.

The Sachse-urethrotome insert may also be introduced into a Storz resectoscope sheath. Thus strictures may be incised at the beginning of a transurethral resection. The knife blade may equally be fitted in place of the cutting loop.

II. Cleaning, Sterilization, and Maintenance of Endoscopic Instruments

1. Instrument Cleaning

I have already drawn attention, when discussing the optimal layout for a transurethral operating suite, to the provision of an instrument room, to its equipment and to the sequence of operations involved in the mechanical cleansing of instruments.

For practical reasons, right-handed staff prefer an arrangement by which the dirty instrument is passed from left to right towards the sterile zone. If this is not possible, the cleaning sequence may of course take place from right to left, even though this may offend against a natural sequence of movements (Fig. 33).

a) Preliminary Disinfection

Immediately after use, instruments should be dismantled as far as necessary and placed in disinfectant solution. The object of this maneuver is to prevent secretions, blood and other organic substances from drying on the instrument and becoming difficult to remove.

We use Helix solution for this process, since it has both detergent and disinfectant properties. All such work is carried out in protective gloves to shield the nurses from infection by virulent organisms. The instruments remain in this solution for 30 min and are only then given their mechanical cleaning. This concept is necessarily time-consuming and, in view of the large number of procedures we carry out every day, requires a considerable stock of instruments with most sets being at least duplicated.

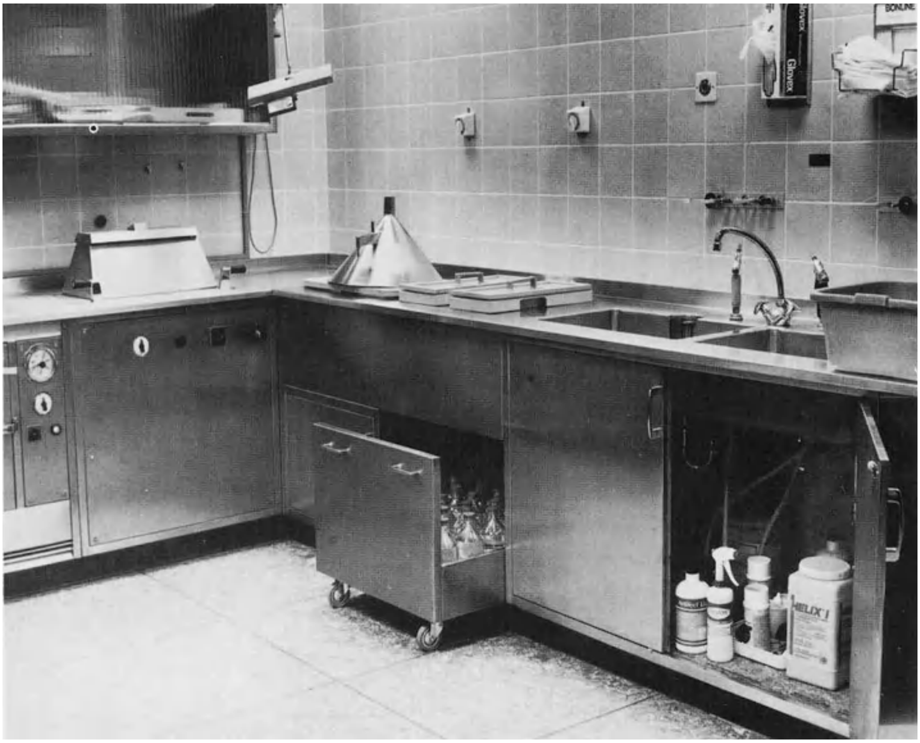

Fig. 33. "Wet department" of the instrument room. To the right of 2 sinks let into the worktop, a plastic trough for the preliminary disinfection of instruments in Helix solution. At this stage the nurses handle the instruments with disposable gloves, available in a wall-mounted dispenser. Before soaking, the instruments must be dismantled. Stock solutions are stored below the work surface. In this particular room work proceeds from right to left: technical factors made this unavoidable. The water jet used for cleaning the instruments is delivered by the pistols seen behind the sink. A wall attachment above contains the various nozzles. Above the left sink may be seen a compressed air point to which a high pressure hose can be attached for blowing out instrument channels. To the left of the sink note the 2 sterilizable sloping-bottomed troughs for wet decontamination of the instruments; on the right the decontamination trough, on the left the distilled water rinse. Time-clocks are on the wall above. Further to the left a clean operating table funnel awaits sterilization. The castored insert under the table is stocked with irrigation fluids and intravenous infusions. On the corner of the wall cabinet a twin-lens illuminated magnifier is available for detailed inspection of instruments

b) Cleaning the Sheaths and Accessories (Excluding Telescopes)

The mechanical cleansing of used instruments is the prerequisite of subsequent decontamination or sterilization. Only if these articles are completely free of blood, secretions and other material is the disinfectant solution able to penetrate all parts of the instrument and have its desired effect. Disinfectant solutions are not capable of penetrating specks of dirt, irrespective of whether these contaminants are proteinaceous or not.

The best mechanical cleansing agent is running water under considerable pressure. Splashes of water are well avoided if this rinsing is carried out under

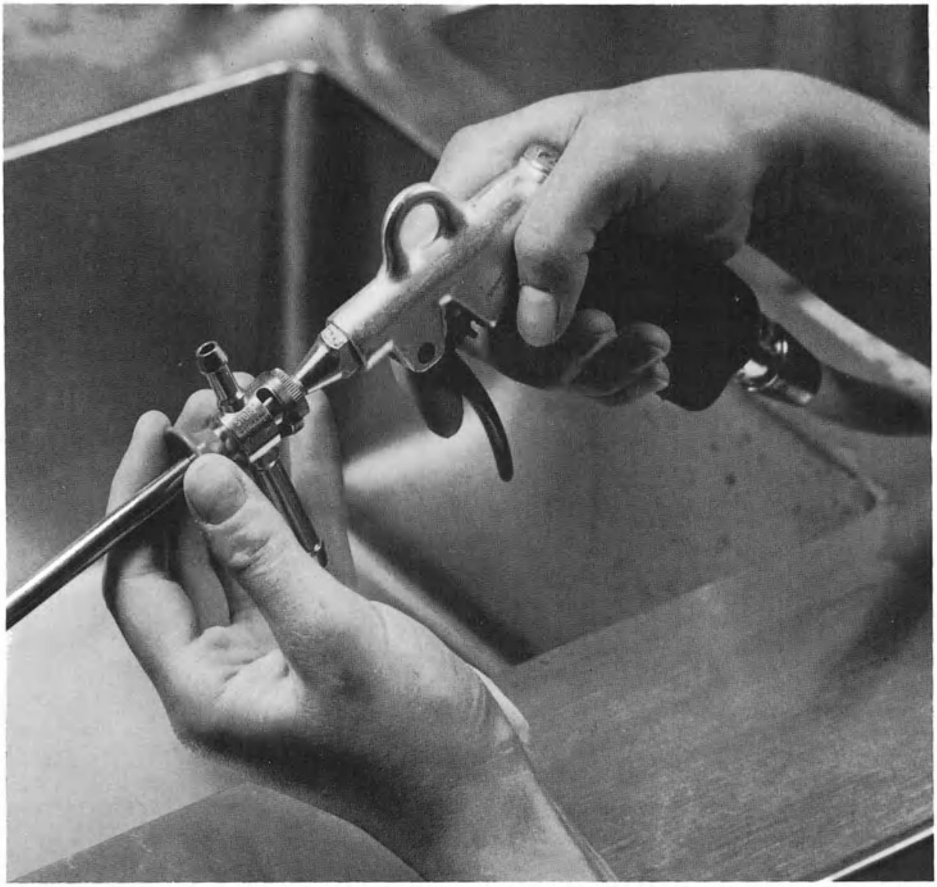

Fig. 34. Cleaning the instruments by water jet. A special pistol mounted behind the worktop sink enables a high pressure water jet to be forced through instrument channels. Since the instruments are soaked immediately after use, blood and secretions are not able to dry on and are thus easily removed by the vigorous water jet

water in a sink. We have found a water pistol with a variety of nozzles extremely useful, since it allows a jet of water to be injected into the various openings of the endoscope (Fig. 34).

Other cleaning equipment consists of small brushes provided by endoscope manufacturers to suit the caliber of various sheaths and instrument channels.

It is also very useful to have a variety of wooden sticks, the tips of which are wrapped in cotton wool. Simple toothpicks and somewhat larger wooden sticks available in household stores for kitchen use are suitable for this purpose. Cotton wool is simply twisted round the tip of these sticks and with a little dexterity the wool ball is adjusted to the caliber of the various channels. Wood has the advantage over metal that cotton wool may be passed through the instruments without scratching the bore.

At the end of this cleaning process we use a nylon loop to pull strips of wick through the sheaths and instruments (Fig. 35). These wicks are chosen

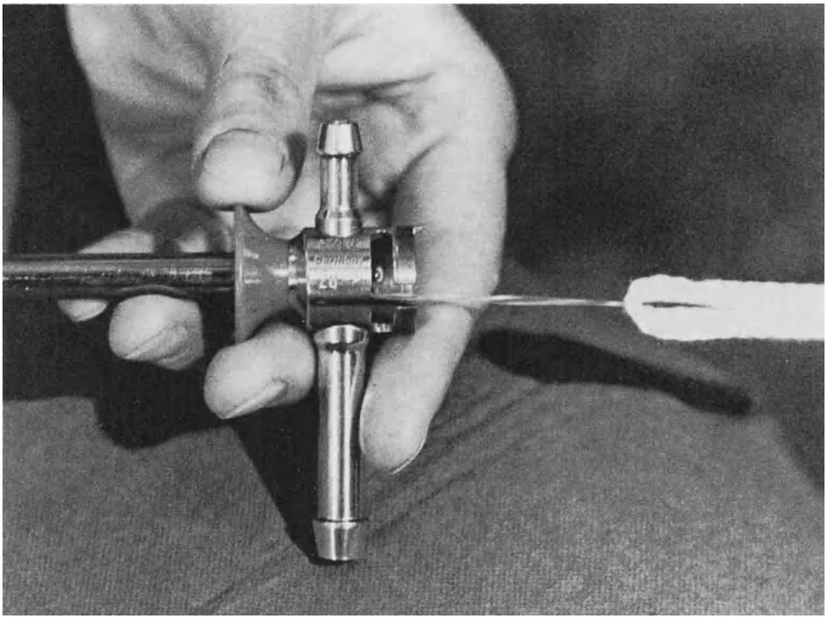

Fig. 35. A nylon loop pulling a wick through a narrow instrument channel

to be a tight fit within the lumen, and their appearance tells whether or not the instrument is properly clean.

Fine edges and corners, which modern instrument design has done so much to eliminate, are picked clean with a tooth-pick (Fig. 36).

All these tasks require a great deal of skill and a sense of responsibility. The schooling of personnel for this work is best carried out within the unit by a well-trained and responsible sister.

c) Cleaning the Telescopes

Because of their smooth and unbroken surfaces, telescopes do not represent a mechanical cleaning problem. On the other hand, the outer surfaces of lenses and the connection points for the light source require special care.

The front lens of a used telescope may be covered with a fine coating of clotted blood not visible to the naked eye. The lens is best cleaned by a gentle twisting motion with a soft cotton cloth, moistened with alcohol and a trace of a liquid washing-up detergent. Abrasive cleaning agents should be strictly avoided, as should prolonged rubbing of the front lens or eyepiece, since this may lead to scratches and blemishes.

We have found it particularly useful to check the instruments under an illuminated magnifier with a twin lens. For general inspection, the larger lens of low magnifying power is quite adequate, while detailed inspection may be undertaken with the superimposed more powerful lens (Fig. 37). It is quite surprising how frequently such optical inspection reveals contamination.

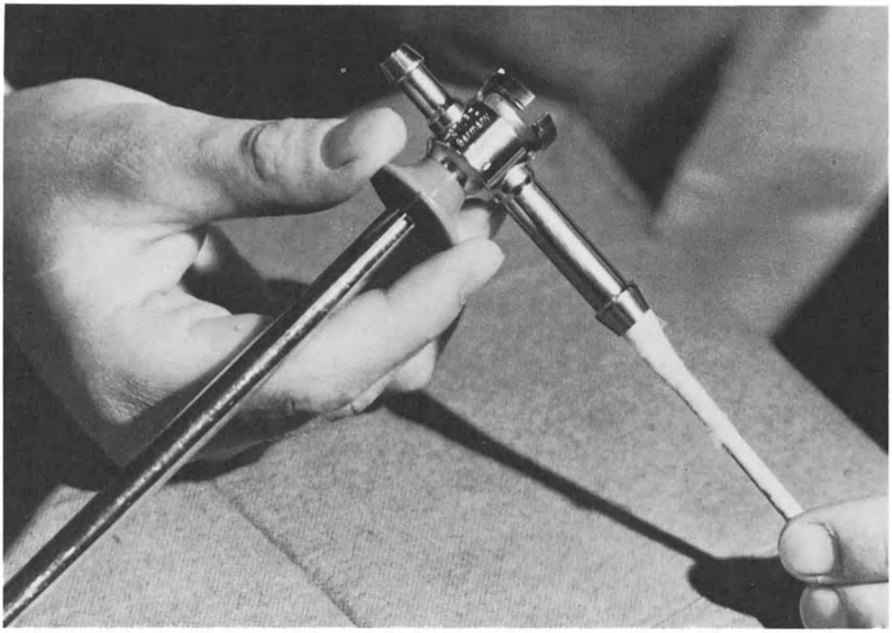

Fig. 36. Corners and crevices are cleaned with cotton wool sticks

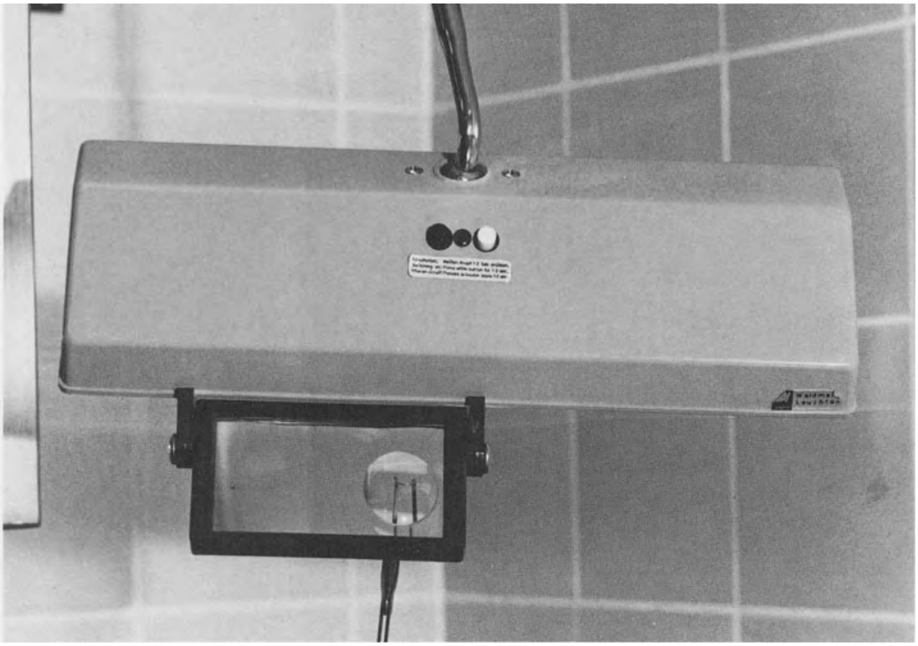

Fig. 37. Illuminated magnifier. Fine detail is best appreciated under optimal lighting and magnification. A variety of illuminated magnifiers of various types are commercially available. Such a unit should be sited at the end of the mechanical preparation area

Particular attention should be paid to the light connection, which should be cleaned with a small cotton-wool stick. This part is also prone to accumulate coatings leading to a substantial loss of light transmission.

Following each cleaning cycle the telescopes should be inspected along the following lines:

1. Cleanliness of the front lens and eyepiece (illuminated magnifier)
2. Unimpeded entry and exit of the light beam
3. Unspoilt surface of the metal tube (dents!)
4. Detection of mechanical distortion
5. View through the telescope. a) Circular field of view? Half-moon? b) Clarity of the image (clouding, partial loss of definition)

Dents in the metal tube are usually caused by carelessness when a heavy object is allowed to fall on the telescope. A telescope may be severely damaged simply by a blow from a falling pair of toothed forceps.

Routine inspection according to this five-point plan will establish with certainty when and by whom damage was caused – an extremely important and fruitful educative measure.

d) Inspecting the Light Cables

The light conduction of fiber optic cables should be tested from time to time. It is natural to use these components for as long as possible and only replace them when their transmitting power is markedly reduced. Since the glass fibers tend to break over a period of use, their condition must be checked periodically.

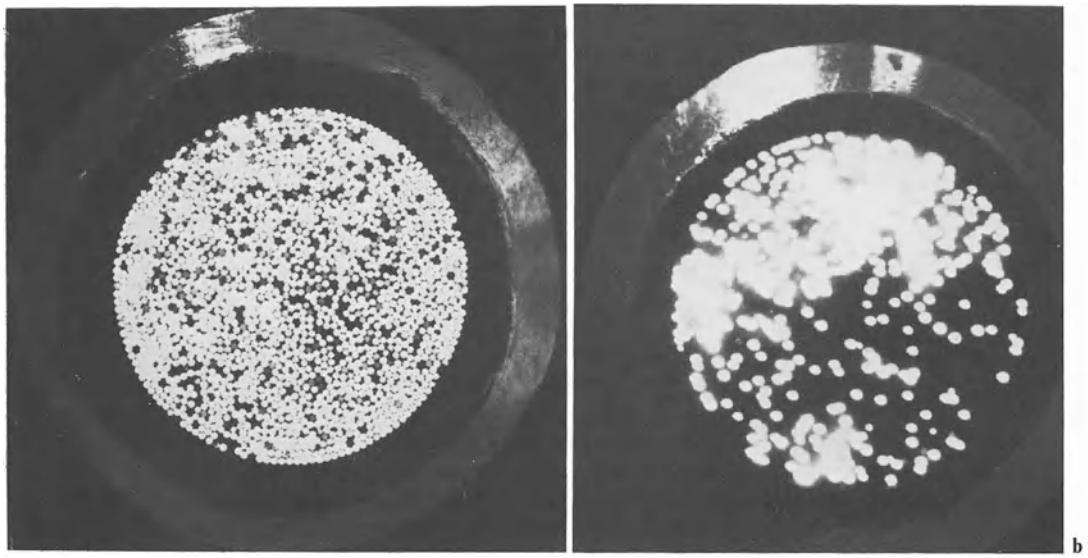

Fig. 38a, b. Inspection of light cables. a A cable in usable condition despite a few broken fibers. **b** This cable should be removed from service immediately and exchanged for a manufacturer's reconditioned unit

Broken fibers may lead to a very substantial loss of brightness, and if this occurs on a large scale it is usually due to excessive bending.

Figure 38 shows two examples of fiber bundles, of which one is still virtually intact but the other has suffered such extensive deterioration that an unacceptable loss of illumination results. It should therefore be sent for reconditioning (usually on an exchange basis).

Inspection is best carried out with a 10 × magnifying glass as used by philatelists.

The light cable is attached to the source and the latter turned to its lowest setting so as not to dazzle the inspecting eye. If this is not possible, the cable may alternatively be directed toward the ceiling light and the exit end then inspected with the magnifying glass. Figures 38a and b correspond in their magnification approximately to the image thus obtained.

At the same time an oblique view of the surface will reveal its state of cleanliness.

2. Sterilization and Decontamination of Instruments

a) The Decontamination Process

Wet decontamination with aqueous solution has, in recent years, gained increasing importance, since the addition of glutaraldehyde means that a 20-min exposure is sufficient to kill all vegetative forms of bacteria, fungi, yeasts and acid-fast bacilli.

It goes without saying that careful mechanical cleaning, as just described, is an absolute prerequisite.

It is important to employ a time-clock which gives an acoustic signal at the end of the decontamination time. The instruments should be soaked in troughs with an inclined bottom, so that air bubbles within the lumen of tubular instruments are eliminated of their own accord. When placing the instrument in the solution, care should be taken that it is completely wetted, if necessary by gentle shaking.

When decontamination is complete the instruments should be soaked for a few minutes in sterile distilled water to wash out the formalin of the first solution (2nd container). Sodium bisulfite should be added to the water in a ratio of 8 g per 4 l of solution. This additive greatly neutralizes the sharp smell of formalin and prevents irritation of the eyes.

The dismantled instruments are now laid out on a sterile drying towel whence they can be removed for further use. Whether the instruments should be reassembled by a nurse wearing sterile gloves or, for training purposes, by the surgeon himself, must be decided on a departmental basis.

Disinfectant containers should routinely be autoclaved.

The decontamination process must be continuously monitored. The best method is to rinse out not only the lumen of instruments, but also that of catheters and ureteric catheters with sterile solution from a disposable syringe. The solution is collected in small specimen tubes and sent to the bacteriology

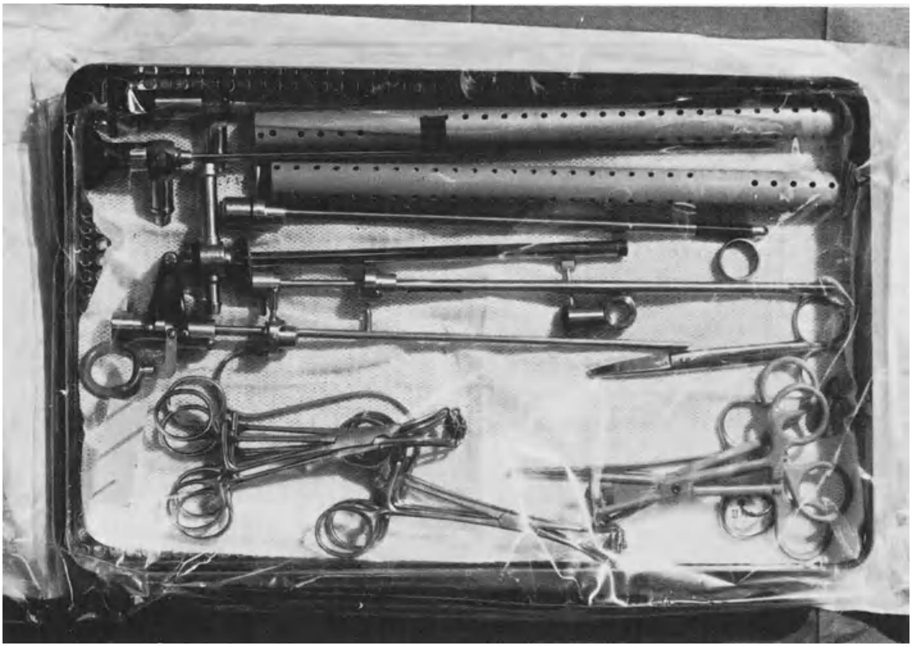

Fig. 39. Packed instrument set. All the instruments required for a given operation (here for TUR) are contained in a metal tray, which is sealed in a plastic bag and sterilized by ethylene oxide. The test strip in the bottom left-hand corner gives information on the duration and effect of the sterilizing process

laboratory. This monitoring is the responsibility of the sister-in-charge, who must keep a record according to a predetermined protocol.

b) Sterilization

Most clinics now use gas sterilization of their instruments with ethylene oxide. Only articles composed entirely of metal, rubber and textiles are sterilized by steam. In our clinic, steam and gas sterilization are carried out in a ratio of approximately 1:3.

No further description is required of the widespread and well-known technique of steam sterilization.

Ethylene oxide has the great advantage as a sterilizing agent that instruments may be packed in advance, since the gas is able to penetrate special plastic films and sterilize the equipment through them.

Sterile instruments may thus be stored prepacked and prepared in a systematic layout. The contents of individual packs may be inspected with ease (Fig. 39).

It is, however, necessary to cleaerate plastic and rubber materials after the sterilization process. Clearation times may be shortened by the use of force ventilated chambers. The supplier will be able to provide precise data for this process.

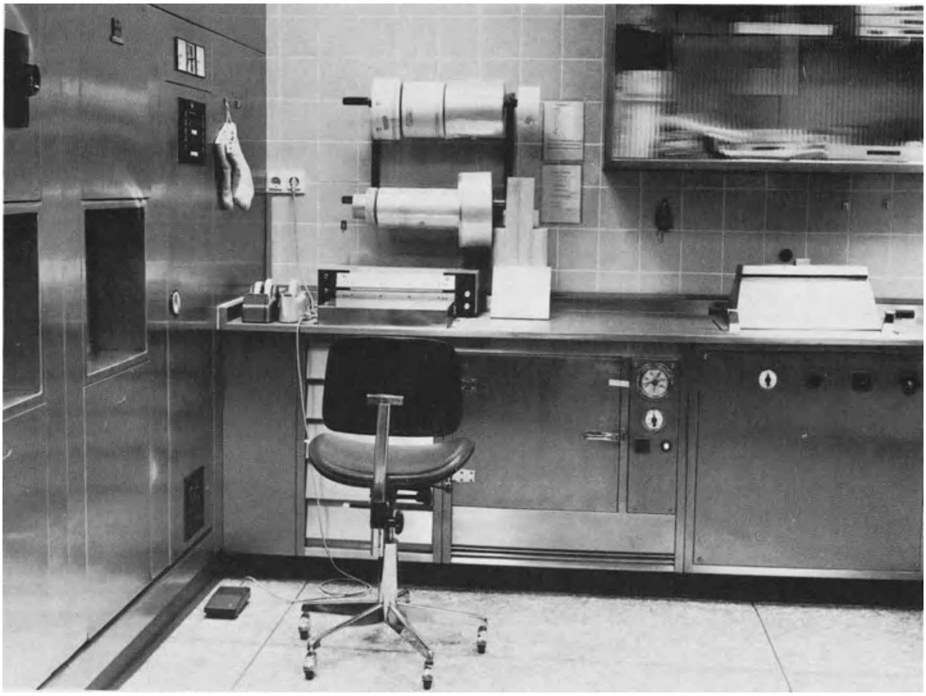

Fig. 40. Working area for packing instruments. On the left the openings of gas and steam sterilizing units. Above the work surface is a dispenser for rolls of plastic sleeving in various widths. A proportion of this is nowadays available as combined paper and plastic sleeving. Below this dispenser is situated the sealing unit, and to the right a variety of small wooden boards corresponding to the length and breadth of various instruments. The plastic foil sleeving is wound around these and cut off at either end, thus providing correct pre-cut lengths for packing a variety of instruments. A footswitch controls the sealing unit and on the left of the latter are rolls of sealing and sterilizer tape for gas and steam sterilization

The instruments are packed in a special working area (Fig. 40). A stock of bags is kept in the form of rolls of plastic sleering of varying breadth hung in a dispenser and passed through a sealing appliance controlled by a foot switch. Before packing, all stopcocks on the instruments should be opened to allow the entry of gas. Maintenance operations (greasing of cocks, etc.) must also be carried out prior to packing.

Sterilization also requires continuous monitoring. The self-adhesive indicator strips only show that the materials have undergone a certain process, but they give no information as to the quality of that process. Monitoring methods involving spore samples are well described in the various manufacturers' and suppliers' literature.

Packed, sterilized instruments may be stored on open shelving. Day-to-day working will be greatly facilitated by keeping an adequate supply of instruments and accessories such as hoses, light cables, evacuator bulbs, loops and similar sundries.

III. High Frequency Technology: Applications and Hazards

By K. Fastenmeier and G. Flachenecker

The successful execution of innumerable transurethral resections by means of high frequency current gives continuing testimony to the suitability and reliability of this method. Nevertheless, we are occasionally reminded of the inherent dangers of electrical current by accidental injuries, such as burns to the patient's skin, muscle stimulation and a proportion of urethral strictures. In order to avoid such hazards the resecting surgeon needs a minimum understanding of electrical processes and the mechanism of action of high frequency current in surgery. Only thus will he detect inadequacies in the equipment and faults in the circuit before the laws of physics render them an inescapable hazard to himself or his patient.

1. Cutting and Coagulating with High Frequency Current

Figure 41 represents the use of high frequency current to make a cut in the urethral tissues. The internal arrangement of the instrument enables high frequency current (I) to be supplied to the tungsten wire cutting loop. This current flows from the surface of the loop into the tissue being cut, thus generating the heat needed to separate the tissues. It must be emphasized that the cutting current then continues into the interior of the patient's body, only to leave it again by means of the attachment point of the indifferent electrode. It is thus inherent in the principle that the patient's body represents part of the electrical circuit within which high frequency current flows.

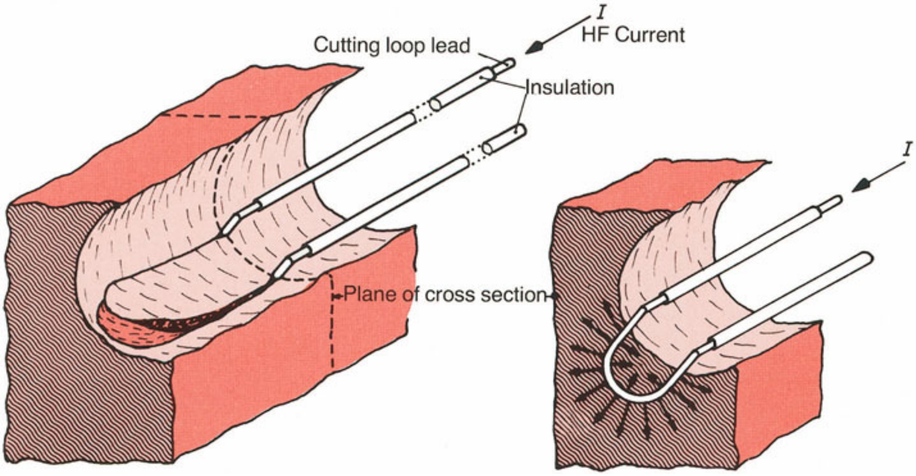

Fig. 41. Cutting by high frequency current. Arrows = current density; HF = high frequency

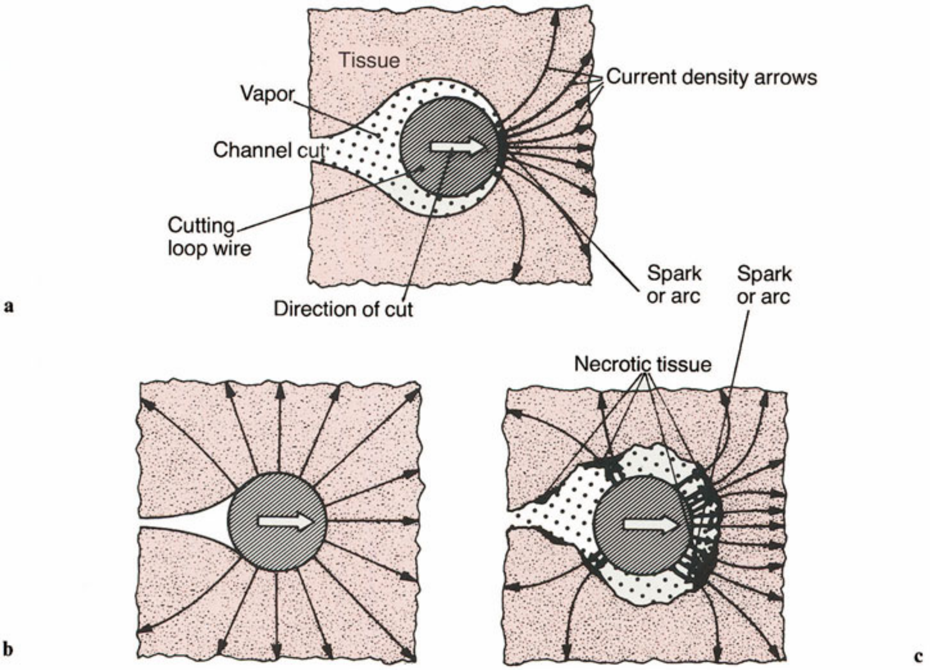

Fig. 42a–c. Current flow from cutting loop to tissue. Effect of various diathermy settings: **a** Correct setting. **b** Too low. **c** Too high

The events which take place at the surface of the loop during the cutting process are explained in Fig. 42. Examples are given of three separate settings of the diathermy unit: optimal, too low and too high.

Figure 42a represents the optimal case. Current flowing from the loop into the surrounding tissue causes intracellular fluid to boil and vaporize so rapidly as to disrupt cell membranes. The cells thus discharge steam so fast as to separate the wire from the tissue, destroying direct electrical contact. However, with correct setting of the equipment the electrical tension will be just adequate for the vapor gap to be bridged by an electrical arc. As Fig. 42a indicates, the arc will be generated on the front of the cutting loop in its direction of travel. The combination of a high temperature arc and restriction of current to a fraction of the loop surface results in an optimal cut requiring the minimum power output from the diathermy.

If the power output (or output voltage) is set too low, then either the cytoplasm will not vaporize at an adequate rate, or the vapor zone will not be bridged by an arc, resulting in the tissue remaining firmly applied to the entire surface of the wire loop. This situation is represented in Fig. 42b, where the current density is inadequate to produce explosive cytoplasmic vaporization, with consequent arrest of the cutting process. The tissue is merely desiccated or coagulated, giving the surgeon a sensation of getting stuck in the tissues.

If, on the other hand, the diathermy is at a higher setting than is strictly necessary for smooth cutting, excess energy is mainly dissipated in the electrical

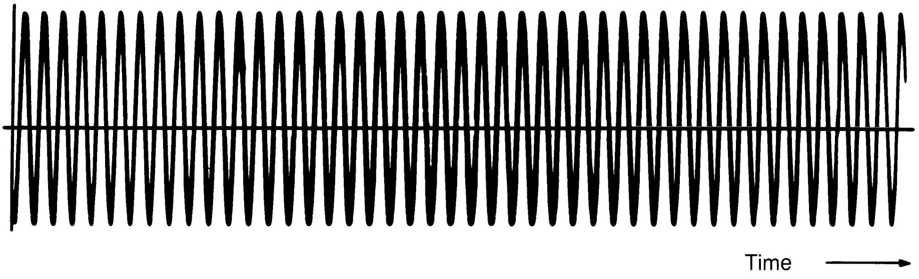

Fig. 43. Time-course of typical cutting current

arc. It may be seen in Fig. 42c how spread of the arc zone onto previously cut tissue leads to excessive necrosis over a superfluously wide area. This is mainly the consequence of excess tissue heating.

There are, however, further undesirable side-effects of an exaggerated arc:

Current stimuli: When a high frequency arc is maintained between two different substances a degree of current rectification takes place. The low frequency currents thus generated will stimulate adjacent nerves and muscles (e.g., stimulation of the obturator nerve). Such electrical stimuli will increase with the intensity of the arc.

Oxyhydrogen: Adequate temperatures are generated within an electrical arc to bring about thermal dissociation of water vapor. The explosive gas mixture thus formed may collect within the bladder and be ignited at a later time. The quantity of gas generated will increase with the intensity of the arc.

It is thus essential to limit arc generation to the minimum required for smooth cutting.

The following operating parameters allow the diathermy unit to provide ideal cutting conditions:

Output voltage:	250–280 V
Output current:	0.2–0.5 A
Output power:	50–150 W

The cutting process thus depends on the thermal effect of high frequency current, the heat required for vaporization of cell water being generated partly in the electrical arc and partly within the tissue itself (Joule effect). This thermal effect is not directly dependent on the frequency of the current. The latter needs to be above 100 kHz because of the ability of low frequency current to stimulate all nerve and muscle in or around the current pathway within the patient by irreversible electrochemical processes (electrolysis). At frequencies above 100 kHz this effect is negligible.

Figure 43 displays the wave form of high frequency current as generated by a modern solid-state diathermy unit set to "cutting".

For coagulation purposes it is undesirable for the current to produce a tissue-separating effect. The cell water should therefore not be so rapidly heated as to vaporize explosively, but should rather diffuse through the cell membrane.

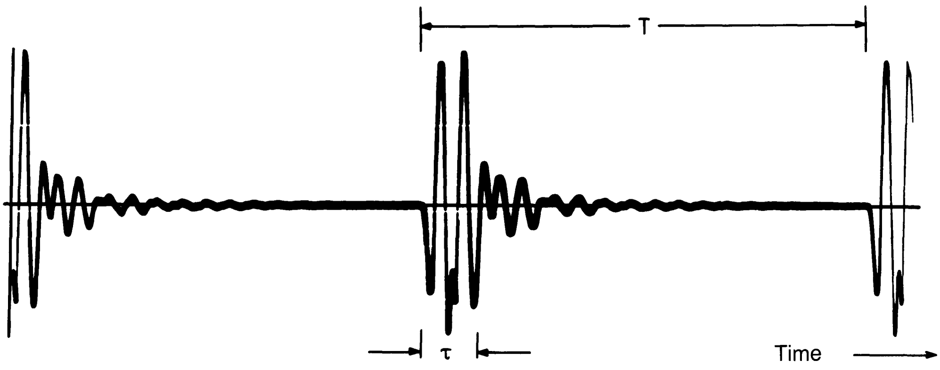

Fig. 44. Time-course of typical coagulating current

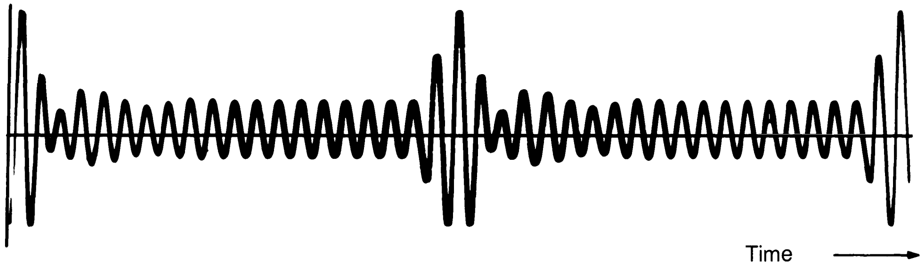

Fig. 45. Time-course of typical blend current

Such a desiccating effect on the tissues may be achieved by the current wave form shown in Fig. 44. This time course is typical of the current produced by an up-to-date high frequency generator in the "coagulate" setting. Note that under these conditions, electrical power is transferred to the tissues in pulses, so that the tissue is denatured without disruption of its cellular architecture. The following electrical values are customary for coagulating diathermy current:

Pulse interval T:	10–100 microseconds
Pulse width τ:	1–20 microseconds
Peak voltage:	up to 3,000 V
Peak current:	up to 2 A
Mean power output:	10–50 W

In addition, many high frequency units are able to provide a "blend" of cutting and coagulating current. Figure 45 represents the wave form of such a blend, the result of which is a cutting action with increased necrosis of the cut surface. For this latter reason, many transurethral surgeons deplore its use. Furthermore, it becomes more difficult and requires higher diathermy settings to make a further cut into this extensively necrosed tissue.

2. The Electrical Circuit in Transurethral Resection

a) Cutting Loop and Connecting Cable

During any transurethral resection the patient's body represents part of a closed electrical circuit, as in Fig. 46. The first part of this circuit, running from the HF-output of the diathermy unit to the cutting loop must be carefully insulated so as to exclude the formation of inadvertent circuits at any point along the course of the cutting cable, the connecting plug to the resectoscope and the internal connection between this and the loop.

Particularly high quality insulation is required for the wiring within the instrument, since on the one hand it must occupy little space, while on the other safe protection is required against the voltages quoted. To avoid insulation breakdown after prolonged periods of use the loop connections should form an integral unit with the loop itself and thus be renewed at every change of loop.

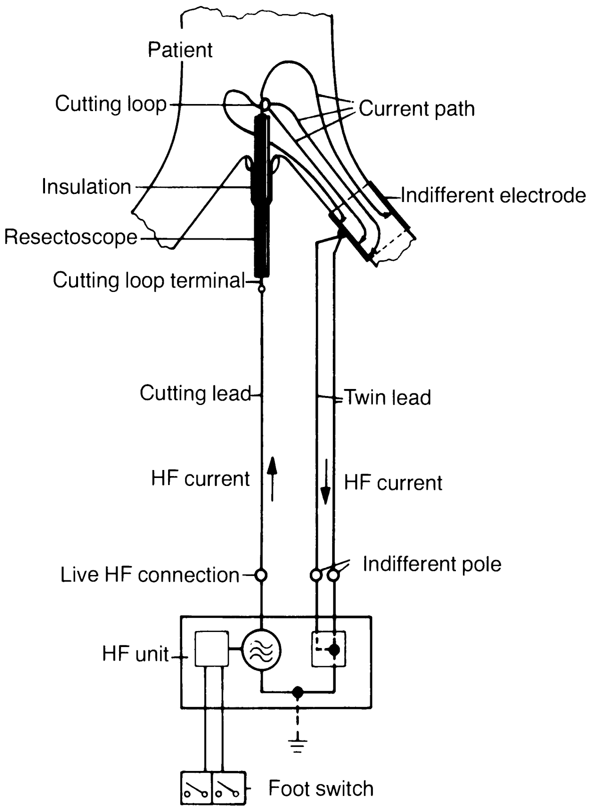
Patient
Cutting loop
Current path
Insulation
Indifferent electrode
Resectoscope
Cutting loop terminal
Cutting lead
Twin lead
HF current
HF current
Live HF connection
Indifferent pole
HF unit
Foot switch

Fig. 46. Electrical circuit during TUR

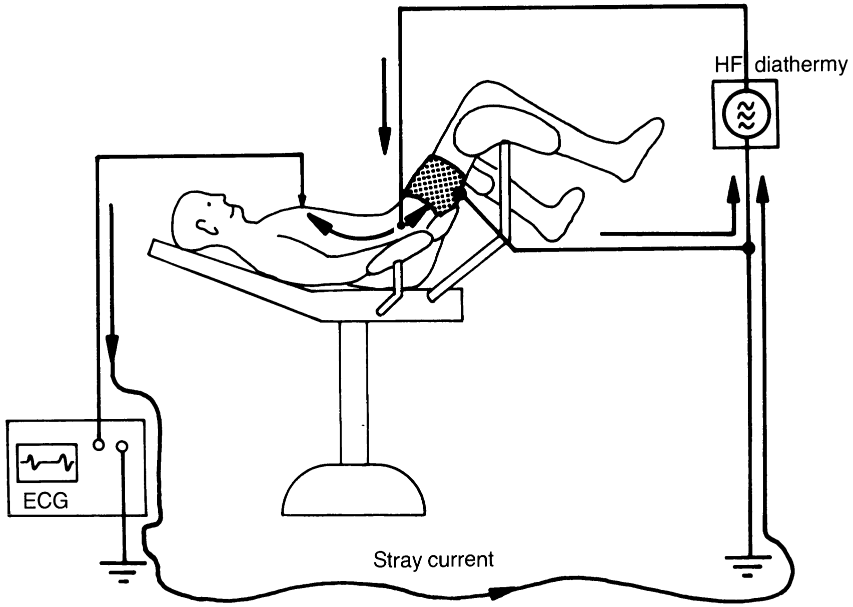

Fig. 47. Stray current via ECG unit due to incorrect attachment of indifferent electrode

b) Indifferent Electrode

The positioning of the indifferent electrode should always be a prime consideration. Perfect electrical contact to the patient's deep tissues is required, if it is to provide the sole pathway of current return, and if contact burns at its site of attachment are to be avoided. It is thus important to maintain a broad area of intimate contact with the skin throughout the operation. More hirsute skin should be carefully shaved. Some reliable elastic device is needed to prevent displacement of the elctrode. The indifferent electrode should overlie an adequate thickness of well-perfused tissue, and its siting over bony prominences is to be strictly avoided.

So as to keep the current pathway within the patient as short as possible, the neutral plate should be as close to the site of operation as possible. The thigh is particularly suitable, although the buttock may also be used with adequate safeguards against slipp. The plate should never be placed rostral to the operating field in the vicinity of the heart, especially in patients with cardiac pacemakers.

Diathermy plate burns are not the only danger inherent in disregarding these points. Poor conduction to the indifferent electrode also increases the danger of current returning to the diathermy by alternative pathways. Figure 47 shows an example involving the ECG. The high current density arising from an inadequate electrode surface, even at modest current intensities, may bring about burns. Spurious circuits may also arise via ventilators and by inadvertent contact between patient and table (either directly or via wet drapes). The stray currents generated in such circuits may give rise to burns, the origin of which cannot be reconstructed in retrospect.

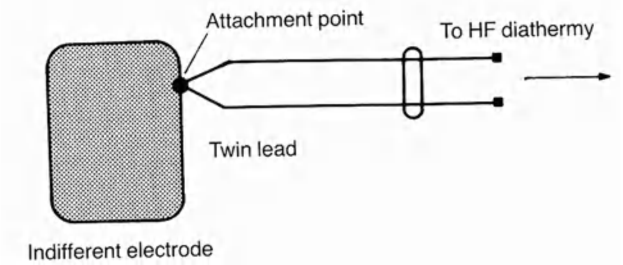

Fig. 48. Twin lead for monitoring indifferent electrode

Not all skin damage with the appearance of electrical burns is truly the consequence of stray current. Constituents of various disinfection and sterilizing agents acting on the patient's skin during the operation may be equally responsible. This is described in the literature as chemical corrosion.

Because of the consummate importance of impeccable contact between the indifferent electrode and the diathermy unit, this connection is uniformly made by a twin lead, of which the two cores meet only at the diathermy plate, as shown in Fig. 48. Interruption of either lead will activate a safety mechanism within the equipment and prevent operation of the diathermy. It should, however, be noted that the equipment used nowadays only tests the circuit between the indifferent electrode and the diathermy unit, not the quality of contact with the patient.

c) Current Pathways Within the Patient – Effect of Electrical Properties of Instruments and Lubricants

The distribution of current within the patient between the cutting loop and neutral electrode is largely dependent on whether the resectoscope sheath has an insulated or metallic conducting surface.

Metal sheaths have a considerably higher electrical conductivity than human tissues. They thus have a powerful influence on current distribution within the body. A proportion of the current finds its way to the indifferent electrode via a section of the sheath, as shown in Fig. 49. This proportion of the current thus traverses the urethra twice, giving rise to a specific current density distribution, as shown in the lower half of Fig. 49. These urethral currents are only innocuous if a low diathermy setting is used, if there are no insulating faults within the instrument and if the lubricating agent is of adequate electrical conductivity.

If the electrical conductivity of the lubricating agent is markedly lower than that of the tissues surrounding the sheath, high density current may flow through localized points of contact, and the resultant local high temperature within the urethra may give rise to strictures. Metal sheaths should, therefore, only be used in conjunction with lubricants with an electrical conductivity σ greater than 1 mS/cm.

These problems of urethral conduction may be avoided by the use of an insulated resectoscope sheath. Transurethral resection may then proceed with a current distribution similar to that shown in Fig. 50. The sheath does not

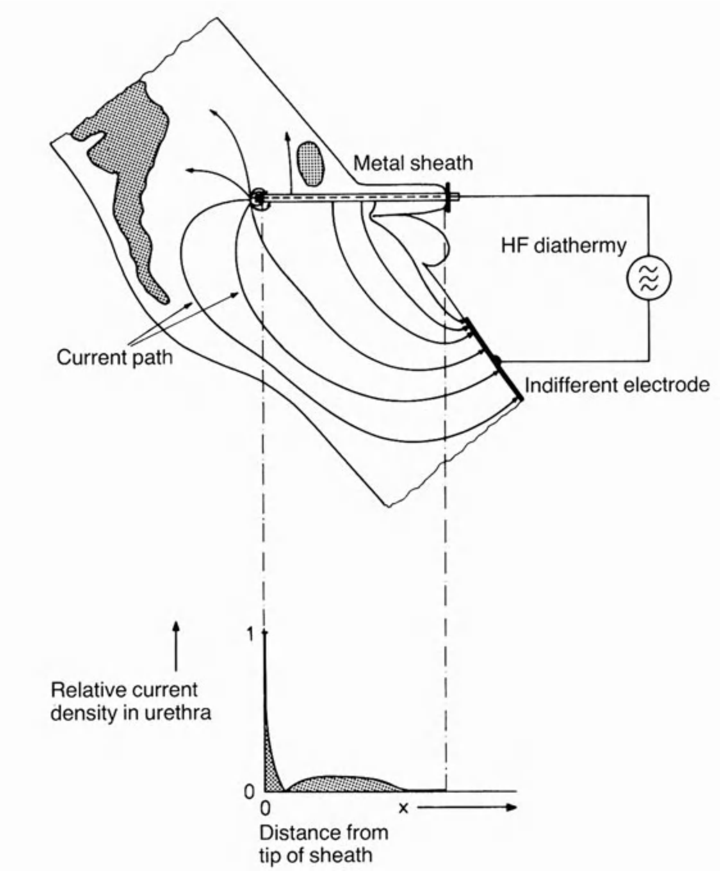
Metal sheath
HF diathermy
Current path
Indifferent electrode
Relative current density in urethra
1
0
0
x
Distance from tip of sheath

Fig. 49. Current distribution within the patient using metal sheath. Below: Relative current distribution along the urethra

form part of the electrical circuit, and the current density across the urethra is negligible. In the special case of plastic-coated metal sheaths, injury to the insulating layer should be carefully avoided. Damaged sheaths should never be used.

The electrical conductivity of the lubricant is of little importance with insulated sheaths, but agents with the lowest possible conductivity are nevertheless recommended ($\sigma < 1$ mS/cm), to prevent currents bridging the gap between the glans and metallic parts of the instrument via traces of lubricant on the insulating collar.

The current distributions shown here for the two types of sheath are only valid if there is no external conduction pathway between resectoscope and ground connection on the diathermy. If, on the other hand, the sheath is grounded, very considerably higher currents may flow to the instrument, and in the case of metal sheaths the urethra will then be subject to extremely dense currents. Care should therefore be taken that the sheath is not inadvertently grounded, e.g., by the attachment of a video camera to the telescope.

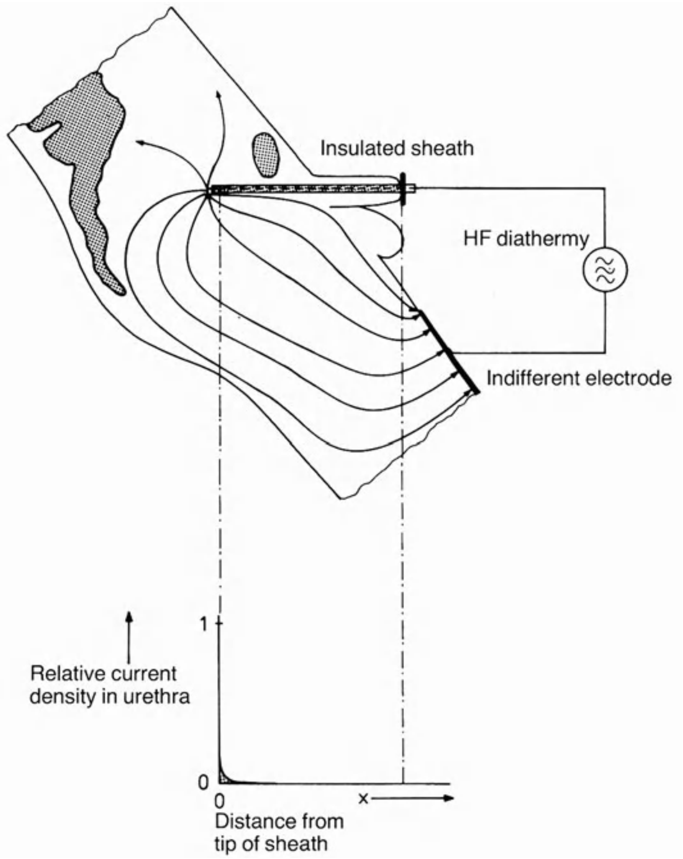
Insulated sheath
HF diathermy
Indifferent electrode
Relative current density in urethra
1
0
0
x
Distance from tip of sheath

Fig. 50. Current distribution within patient using Teflon sheath. Below: Relative current distribution along urethra (scale as in Fig. 49)

Comparison of the two types of sheath from an electrical point of view gives a clear advantage to the insulated sheath since the urethra is not then subject to any current. At the same time, insulated sheaths have mechanical and chemical properties which influence their care and maintenance. Thus an increased deaeration time is required following gas sterilization, and other methods of sterilization are therefore to be preferred for such sheaths.

d) Insulation Faults within the Instrument – Electrical Conductivity of Irrigation Fluid

An insulation fault between instrument and cutting loop connections will divert a proportion of high frequency current to the instrument. Where metal sheaths are used this will result in an increased current density in the urethra, with its concomitant risk of stricture. The use of an insulated sheath will certainly

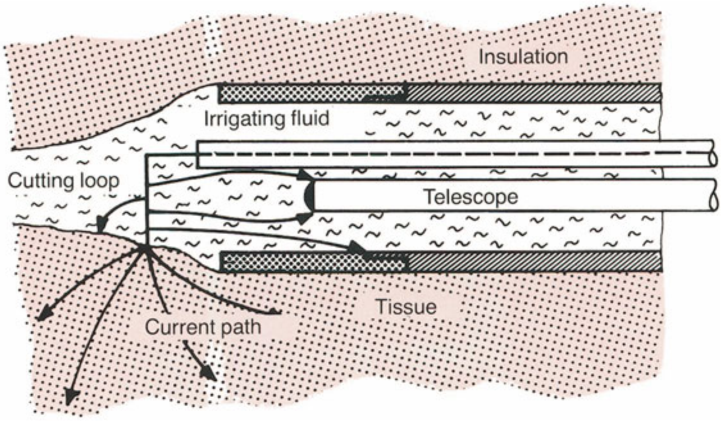

Fig. 51. Leakage current to instrument and surrounding tissue via conductive irrigating fluid

protect the patient, but higher voltages may be generated in metal parts of the instrument with a consequent shock hazard to the operator.

Furthermore, in either case, but particularly when using a metal sheath, leakage current to the instrument is not available for cutting or coagulation. The result is a poor quality cut and reduced coagulating power. If, therefore, the usual diathermy setting appear inadequate during a transurethral resection they should not be mindlessly increased – rather the instrument should be carefully checked for insulation faults.

These faults may arise either from mechanical damage to the cutting loop connections, from excess diathermy voltage or from damp penetration. In particular, the connecting plug between cutting cable and resectoscope should be carefully protected from moisture throughout the very longest procedures. Not infrequently a hissing noise in the resectoscope when cutting or coagulating may indicate stray vaporization or arcing over due to moisture patches.

Excessive electrical conductivity of the irrigating fluid will have a similar effect to that of insulation faults, and this is particularly noticeable when saline is inadvertently used. Similar but less marked effects occur with tapwater of high ionic content, giving rise to particularly noticeable difficulty at the beginning of a cut and when coagulating, since the loop is then mainly immersed in irrigation fluid (Fig. 51). A proportion of the current will flow through the fluid to adjacent tissue and the instrument. Specially prepared irrigation fluids of low ionic content, such as are commercially available for TUR, are thus to be preferred to simple tapwater. It should be noted that an influx of blood may equally increase the electrical conductivity of the fluid, particularly in the presence of sluggish or continuous irrigation. Figure 52 illustrates this state of affairs.

Substantial short circuits between loop and instrument may be prevented by avoiding the use of bent or badly worn cutting loops. In either case the wire loop may come into contact with the telescope. Distorted loops should therefore be carefully straightened, and worn ones discarded at an early juncture, since breakage during the cutting process may allow sudden bending.

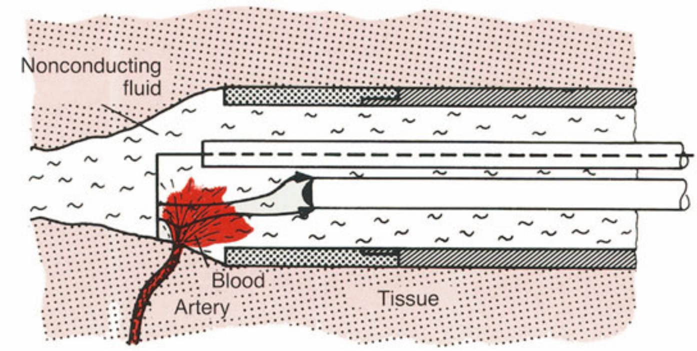
Nonconducting fluid
Blood
Artery
Tissue

Fig. 52. Influx of blood renders irrigating fluid more conductive

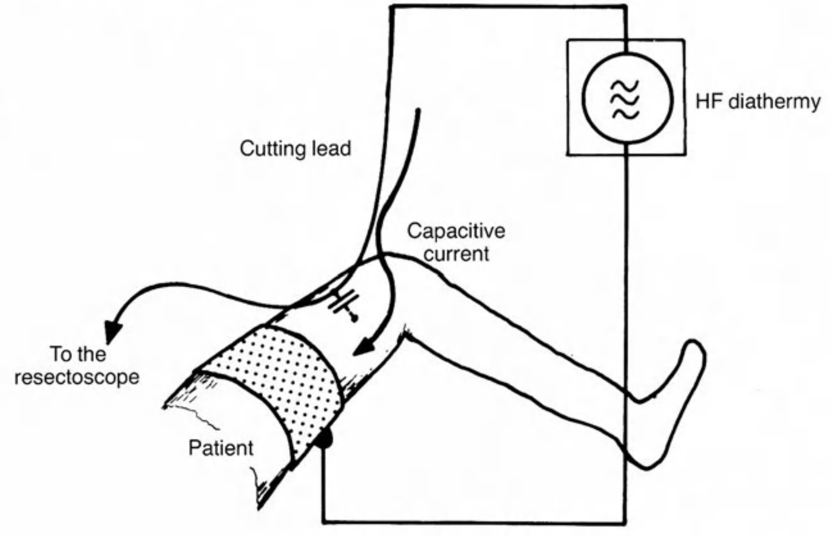
HF diathermy
Cutting lead
Capacitive current
To the resectoscope
Patient

Fig. 53. Burn hazard due to capacitive current between cutting lead and patient

e) Capacitive Effects

High frequency potentials differ from direct current in their ability to give rise to capacitive current even in the absence of metallic contact. This has various consequences for transurethral surgery, but only the most important are discussed here.

If, as in Fig. 53, the cutting cable remains in contact with a single naked area of the patient's skin throughout an operation, capacitive currents may give rise to a skin burn despite impeccable insulation. The slightest increase in separation, e.g., by a dry drape, between cable and patient will minimize such effects.

In the presence of an insulation fault within the resectoscope, considerably increased potentials are generated within the instrument, particularly if it is

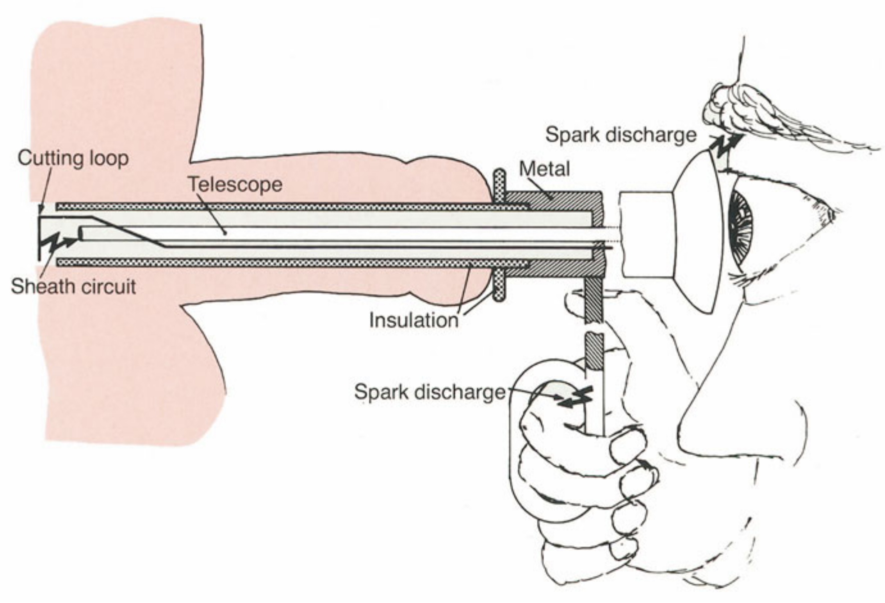

Fig. 54. Spark discharge to surgeon in event of short circuit in insulated sheath resectoscope

of the insulated type. The operating surgeon may then receive a shock, even if there is no metallic conducting pathway between him and the ground potential of the operating room and diathermy unit. The current transmitted to him (represented in Fig. 54 as a spark discharge following short circuit between the cutting loop and the telescope) will then take a capacitive route back to the diathermy. Instruments with insulated sheaths should therefore also be equipped with insulating eyepieces.

An additional capacitive pathway within the instrument is across the cutting loop insulation. This has, however, been shown to be of negligible magnitude in modern resectoscopes.

3. Hints for the Avoidance of Electrical Hazards During Transurethral Resection

	Pay attention to	To avoid possible
Indifferent electrode:	1. Surface to be kept clean and free of corrodent film 2. To be sited over muscle (preferably on thigh or, with additional care, under buttocks) 3. Entire surface to be in contact 4. Not to be applied to hirsute skin (shave first) 5. Secure to prevent slipping	Skin burns under the indifferent electrode plate; skin burns anywhere on the body surface.

	Pay attention to	To avoid possible
	6. Reliable connection to diathermy unit	Burns anywhere on the patient's body surface
	7. Attach caudal to the site of operation (thighs or buttocks)	Increased influence on cardiac pacemakers
Cutting cable: (connecting cable from diathermy to resectoscope)	1. Never use cable with damaged insulation	General danger of burns
	2. Careful connection to instrument and diathermy	Arcing over at resectoscope plug, damage to plug
	3. Avoid contact with *naked* skin of patient (protect with towels)	Skin burn to the patient at the contact point with insulation (capacitive!)
Patient:	1. No metallic contact with table	Contact burns
	2. Avoid damp pathway between patient and operating table	Conducting bridges between patient and table: burns hazard; Hazard of chemical corrosion without electrical cause
Instrument, cutting loop:	1. Cutting cable plug to be kept dry	Creepage currents to instrument and urethra; Urethral stricture with metal sheath or electric shock to surgeon with insulated sheaths
	2. Discard loops with insulation faults (hissing noise when cutting)	
	3. Straighten or exchange distorted loops	Short circuit loop to telescope; Urethral strictures with metal sheath or electric shock to surgeon with insulated sheath, damage to telescope
	4. Early exchange of worn loops	
	5. Regular check on insulated sheaths	Stricture hazard from short circuits within instrument
	6. Use insulated eye piece with insulated sheath	Burns to surgeon if short circuit within the instrument
	7. Observe deaeration time or avoid gas sterilization of insulated sheaths	Stricture of non-electrical cause
	8. Do not ground instrument	Urethral stricture
Lubricant:	1. *Metal sheaths require good conductivity lubricants* (conductivity $\sigma > 1$ mS/cm)	Stricture following high density current in urethra
	2. *Insulated sheaths require low conductivity lubricant* (conductivity $\sigma < 1$ mS/cm or carefully avoid lubricant bridges between glans and metallic parts)	Thermal damage to glans penis

	Pay attention to	To avoid possible
Irrigation fluid:	1. Prefer non-conducting fluids 2. Never use highly conductive fluids (saline) 3. Avoid tap water of high ionic content (electrical conductivity) 4. Note increased conductivity due to blood contamination in sluggish or continuous irrigation	Currents from loop via irrigating fluid to instrument and urethra; Poor cutting; High diathermy setting leading to increased thermal load on patient
Diathermy unit:	1. Use lowest possible setting (smallest possible arc between loop and tissue)	Increased thermal load to patient, especially with metal sheaths; Stimulation of muscles and nerves (especially obturator nerve and sphincter muscle) due to rectifying effect of excessive cutting arc; Oxyhydrogen formation and explosion hazard with excessive arc; Increased tissue necrosis with excessive arc
	2. Check circuit rather than increase diathermy setting if poor cutting and coagulating power; in particular check: indifferent electrode, resectoscope cable plug, loop insulation, irrigation fluid	Increase in all electrical hazards
Ancillary equipment: (ECG, ventilator, etc)	All connections between patient and surroundings to be poorly conducting (high resistance) Avoid spurious electrical contact between patient and metal theater equipment	Burns to patient

Chapter C

Preoperative Requirements

I. Assessment of the Patient

A textbook of operative surgery such as this is not the proper place to discuss details of medical and urologic assessment. Only those factors are mentioned which will influence the decision to operate and the choice of operation. Particular attention is paid to the surgical anatomy of the diseased bladder neck and its anatomical relations.

The decision to operate arises mainly from the individual patient's micturition symptoms and from the results of routine investigations. The type of operative procedure selected on the basis of findings of rectal palpation, the cystourethrogram and the findings at urethrocystoscopy.

1. The History

Inquiry into the general past medical history of a patient not only reveals previous illnesses, but also allows some assessment of the patient's personality. A general impression of his degree of physical and mental agility may weigh as heavily with the surgeon as the result of any individual investigation, when it comes to a decision on whether to operate. In the absence of urologic or general medical contraindications, the patients's wishes and his willingness (and that of his family!) to undergo anything for the sake of normal urinary function has very considerable significance. On the other hand, any decision should take account of such factors as disproportionate fear of surgery despite pronounced symptoms.

The general medical history should include such questions as excercise tolerance, metabolic disorders, coagulation defects previous myocardial infarcts or cerebrovascular accidents as well as the presence or absence of a cardiac pacemaker.

Patients frequently omit to mention previous urologic illnesses and operations: these should therefore be specifically asked after. Symptoms of micturition should occupy a central place in the patient's history. Subject to the physical findings and the outcome of investigations, the symptomatology alone may at this stage suffice for a preliminary decision on the advisability of surgery.

2. Urological Assessment

Rectal palpation of the prostate, radiologic investigation of the urinary tract (excretion urography and cystourethrogram) and cystourethroscopy form the basis of any decision on the type of operation to be planned.

The combined outcome of these investigations allows an accurate assessment of the upper and lower urinary tract and the extent of pathologic change therein. Uroflowmetry provides valuable additional dynamic information, especially when the patient is a poor historian.

a) Rectal Examination

I prefer to perform rectal examination in the left lateral position with the legs drawn up and the hips flexed. This position may be achieved even by the most elderly and decrepit patient and is reached by simply rolling over from the supine position in which the abdomen, hernial orifices and genitalia were examined. Rectal palpation should assess the following:

1. Extent of the gland ('organ limits')
2. Protrusion into the rectum ('volume')
3. Symmetry
4. Position of the gland (high lying – low lying)
5. Mobility
6. Consistency

The validity of rectal assessment. Rectal examination provides a first encounter, often a decisive one, with the diseased organ. In the majority of cases, it is only the rectal examination that will allow one to decide whether, in the presence of suitable indications, transurethral or open surgery is more appropriate. Small to medium adenomas, i.e., hyperplasia with a specimen weight of up to 50 g, may be assessed in this fashion.

It goes without saying that the palpating finger must search for a carcinoma of the prostate or rectum within its reach. Further investigations such as biopsy and proctosigmoidoscopy should be carried out as appropriate. With regard to the assessment of prostatic volume it should be noted that rectal examination only encompasses an enlargement in the region of the prostatic urethra, not within the bladder.

b) Radiologic Investigation of the Urinary Tract

α) Excretion Urogram. Intravenous urogram allows accurate assessment of urinary flow or the presence of obstruction in the upper urinary tract. Additional findings such as tumors or calculous disease of the upper urinary tract are rare but nevertheless add to the justification for this investigation which provides such valuable functional assessment as well as displaying the bladder before and after micturition.

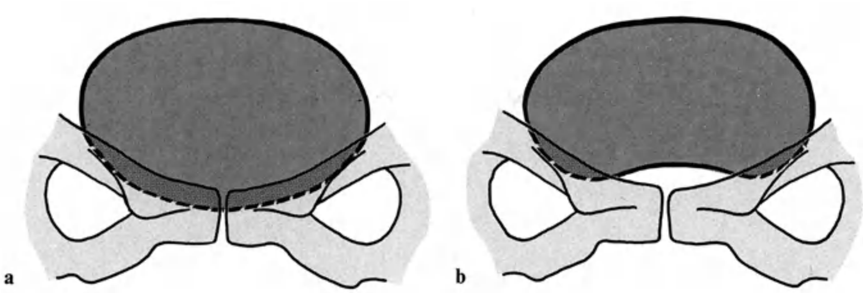

Fig. 55a, b. Diagrammatic representation of the bladder outline, as seen on excretion urogram. a Normal outline of bladder filled almost to maximal capcity. The bladder base may be seen below the superior margin of the symphysis. **b** Elevation of the bladder base by a small mainly endourethral adenoma. (Figure 55 and 56 are derived from clinical radiography of which the findings were subsequently confirmed endoscopically)

When surgery is contemplated the presence of residual urine and filling defects in the base of the bladder assume special importance.

In conjunction with the rectal findings the i.v. urogram will provide working criteria for the type of operation to be considered.

The level of the base of the bladder in relation to the symphysis pubis is a guide to the degree of enlargement in the urethral part of the gland. Endovesical protrusion, on the other hand, appears as an isolated filling defect in the medial part of the bladder. In typical cases, the filling defect may be identified as being due to the median or the lateral lobes (see Figs. 55 and 56).

Pseudodiverticula, true diverticula and filling defects due to nonopaque calculi or tumors of the bladder are further features to be considered.

Finally, the after micturition film allows a crude assessment of residual urine. This should be accepted only with caution in more sensitive patients, who may have difficulty in fully emptying their bladder to command. The presence of an apparently high residual urine on the after micturition film, in combination with the measurement of repeatedly normal residual volumes after micturition in relaxing surroundings is a phenomenon well known to every experienced urologist.

β) Cystourethrogram. The final radiologic investigation of cystourethrogram may so complete the anatomic data that cystoscopy frequently has little to add (Fig. 57).

We carry out this investigation routinely, with the following in mind:

1. Caliber of the urethra
2. Demonstration of bladder neck length
3. Demonstration of urethral angles
4. Demonstration of bladder contour (see Fig. 62)

In the investigation of benign prostatic hyperplasia we consider retrograde cystourethrogram to be adequate and have dispensed with micturating films of the urethra, since this is anyway only possible in the small proportion of patients who still have adequate urethral flow.

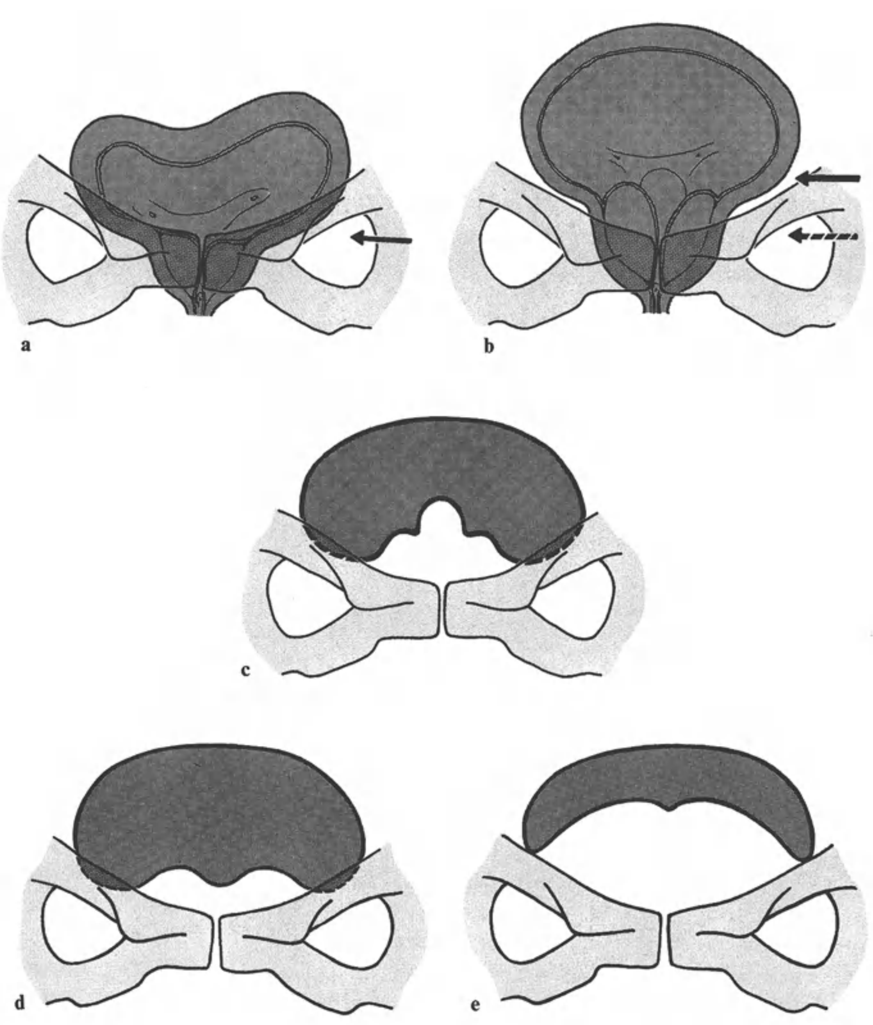

Fig. 56a–e. Diagrammatic representation of the radiologic picture obtained in the presence of endourethral and endovesical adenomas. a, b Configuration of prostatic and bladder anatomy within the pelvic ring, showing the relationship between bladder, prostate and pelvic skeleton. **a** Arrangement of normal-sized prostate. **b** Elevation of bladder base by a small mainly endourethral, only partially endovesical adenoma. **c** The same configuration, showing the radiologic bladder outline. **d** Mild elevation of the bladder base due to partially endovesical enlargement of the lateral lobes. **e** Marked endourethral hyperplasia of both lateral lobes without endovesical moiety

Comparison of the dimensions of the prostate on cystourethrogram and the weights of surgical specimens reveals a significant correlation between the length of the prostatic urethra in centimeters and the weight of tissue in grams. We have therefore come to the conclusion that the length of the prostatic urethra is the only reliable criterion for the size of an adenoma.

When performing cystourethrogram it is thus important to achieve the best possible views of the prostatic urethra.

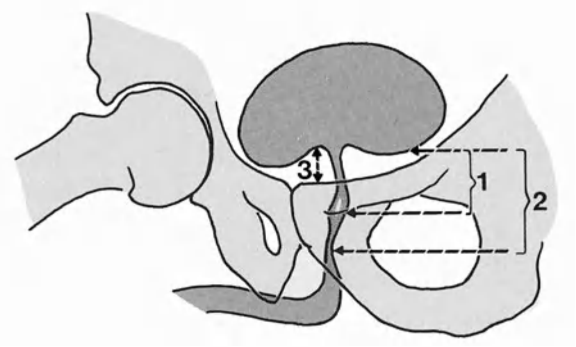

Fig. 57. Principle dimensions measured on the cystourethrogram. 1 Length of the prostatic urethra (distance verumontanum – internal meatus), 2 Distance from external sphincter mechanism to internal meatus (the true length of the lateral lobes lies somewhere between the values of 1 and 2, since the lateral lobes often extend distally beyond the verumontanum), 3 Height of the bladder base above the symphysis as a measure of endourethral hyperplasia. The ventral (left) curvature of the prostatic urethra is indicative of the extent to which the latter is distorted by a median lobe (see also Fig. 63)

An important clue as to the configuration of the proximal bladder neck may be found in the angle at which the urethra opens into the bladder. The presence of a tall median lobe projecting far into the urethra, thus presenting a potential obstacle to instrumentation, may then be appreciated prior to cystoscopy.

The demonstration of urethral strictures is of significance in relation to potential problems of instrumentation and for the documentation of a preoperative narrowing of the urethra.

c) Indications for Preoperative Outpatient Cystoscopy

All the above investigations may be carried out on an outpatient basis. We generally omit cystoscopy unless there is a specific indication, such as hematuria, symptoms of a bladder calculus or even the suspicion of a bladder tumor. In the presence of such indications, however, we have no hesitation in performing outpatient cystoscopy under urethral anesthesia, with the strict proviso od. stipulation that the standard of asepsis should equal that of an operating room environment (disinfection, sterile drapes and instruments). The use of suitable, and if necessary retrograde-viewing, telescopes usually allows such an excellent view of the bladder that general anesthesia is required only for the most sensitive and anxious patients.

As always, there is an exception to this rule: If previous investigations have failed to indicate with certainty whether transurethral or open prostatectomy should be performed, we proceed to inspect the bladder neck and bladder in the outpatient clinic prior to arranging surgery. This is mainly for organizational reasons related to the planning of operating lists.

Such doubts as to the suitability of one or the other type of procedure arise only with large adenomas when a decision on transurethral or open surgery must otherwise be based on measurements of bladder neck length and the urethral cleft. The situation alters if coexistent disease such as severe infection, tumor, urethral stricture or a protuberant median lobe render instrumentation or inspection of the bladder painful to the patient. Under such conditions cystoscopy should be abandoned at an early stage, and under no circumstances should the instrument be forcefully introduced.

It goes without saying that full routine laboratory investigation is required in addition to the above. As well as urinalysis and bacteriology, hematologic and blood chemical parameters should be measured. Since the majority of such investigations are nowadays performed by auto-analyzers measuring a full range of parameters, it is quite inappropriate to limit the investigations requested on grounds of economy alone.

Assessment along the above lines will always allow a decision to be made on advising surgery or expectant treatment. Furthermore, a firm basis is provided for the choice of perative procedure.

II. Indications for Surgery

1. General Considerations

In discussing the indications for prostatic adenomectomy, a sharp distinction should be made between general and special indications. The former are indications for surgery as such, without considering how the gland is to be removed. The latter are concerned with deciding on the most suitable procedure. Finally the contraindications should also be considered, both as they apply to surgery and to transurethral procedures in particular.

No one who has spent a considerable period of time looking after patients with bladder outflow disturbances can fail to be surprised by the variability in the patient's own assessment of his symptoms. Many men become so habituated to a gradual and almost imperceptible deterioration in micturition as to accept this as a normal fact of life. Many will continue in this fatalistic attitude until hygienic requirements force their wives to bring them to a urologist for treatment of overflow incontinence. On the other hand, there is a group of men who will enthusiastically seek surgical relief of the slightest impairment of micturition.

A great deal of responsibility therefore devolves on the surgeon in his assessment. He has to avoid carrying out unnecessary operations and yet to use his medical authority to convince those patients for whom surgery is urgently indicated.

In the following sections typical indications are described, yet these should only be regarded as crude guidelines, since every case will have its own specific features.

2. General Indications for Prostatectomy

a) Acute Retention of Urine

Inability to urinate may be one of the most important grounds on which a patient is advised to undergo prostatic surgery. Acute retention may occur suddenly without any premonitory symptoms. If attempts at spontaneous micturition fail after repeated catheterization, an indwelling catheter will be required while the patient is prepared for surgery. Intermittent catheterization or the establishment of a suprapubic fistula may also be used to span a short preoperative waiting period.

b) Recurrent Retention

In contrast to those with acute irreversible retention, these patients are able to pass urine normally after decompression of the bladder by catheterization. They therefore not infrequently fail to see the need for surgery. Nevertheless, we always advise them to undergo operation, since the passage of time almost inevitable renders their retention irreversible. An intravenous urogram may signifcantly influence the decision to operate. If a patient with a large adenoma has the slightest degree of ureteric holdup, even in the absence of residual urine, one should advise more urgent surgery.

c) Increasing Residual Volume

A small residual urine volume does not in itself represent an indication for surgery unless there are quite marked subjective symptoms, although it is not of course possible to give an exact figure above which an operation is required and below which it is not: An approximate dividing line lies in the region of 100–150 ml. In such patients, clinical progress may be the deciding factor, with progressive deterioration indicating a rather greater need for surgery than a static condition. More general factors should also be taken into account in these patients, and if their general condition deteriorates despite apparently static urologic symptoms and findings, early surgery should be considered, since the risks of surgery can only increase with time.

d) Chronic Retention with Upper Tract Obstruction

In these cases the outcome of radiologic investigation is the major reason for advising surgery. In the presence of the typical signs of ureteric back pressure there is an absolute indication for early surgery, unless renal function needs first to be improved by a period of indwelling urethral or suprapubic catheterization.

e) Recurrent Ineradicable Infection

This group comprises all those patients who suffer from recurrent urinary tract infections or in whom the urine cannot be sterilized. They may remain relatively free of symptoms as long as they take antibiotics, yet their old symptoms will return shortly after discontinuing treatment. It is not uncommon to find residual urine volumes of less than 100 ml, which may even disappear almost completely with antibacterial therapy. During periods of infection the symptoms are often substantial. Patients will them develop frequency and nocturia, often associated with marked dysuria and poor stream. Specific treatment often relieves or almost entirely abolishes the complaint, and radiology is often unhelpful. Secondary phosphatic calculi occasionally form in the bladder in which case they represent an absolute indication for surgery in fundamentally operable patients. Surgery should, however, be advised in these patients, even in the absence of calculi, whether the gland be large or small. Operation must be performed under antibiotic cover after bacteriologic diagnosis. Some of these patients nevertheless refuse to accept the need for operation as long as antibiotics provide relief. Regrettably, they only come to surgery when a resistant organism makes their condition intolerable.

f) Hemorrhage from Prostatic Veins

Just as some patients suffer from recurrent retention, one comes across others who at irregular intervals suffer episodes of hematuria which may on occasion be so severe as to require the evacuation of clots where these are markedly interfering with micturition. Some hemorrhages cease spontaneously. On the other hand the bleeding may be so brisk as to be life-threatening and require a cystoscopic attempt at arresting the hemorrhage by coagulation. The problems associated with this maneuver are discussed in the chapter on operative treatment. Whenever this is unsuccessful, i.e., when the hemorrhage is only reduced but not completely arrested, there is a vital indication for emergency prostatectomy, which paradoxically represents the only chance of stopping the bleeding.

g) Bladder Calculi

The formation of a bladder calculus is often true evidence of a bladder outflow disorder. The usual explanation for the pathogenesis of such calculi is the accumulation of uric acid crystals in a small amount of residual urine in the base of the bladder (10–20 ml may suffice), and they are said to form calculi by aggregation. This assumption is given weight by the failure of such calculi to reoccur if free drainage has been re-established by prostatectomy, even though the biochemical situation has not altered. The crystals are then cleared during micturition. Equally, the clinical course of patients whose stones were eradicated by chemical means, perhaps because of a hesitancy to operate, leads nevertheless with inevitability to prostatectomy.

h) Bladder Diverticula

With the odd congenital exception, formation of a bladder diverticulum results from increased outflow resistance at the bladder neck. There is thus an indication for the removal of this obstacle. It is usually possible to remove the diverticulum during the same hospital admission. If a diverticulum occurs in association with a small adenoma, bladder neck fibrosis or a transverse bar, it is our practice to first excise the diverticulum by a suprapubic approach and subsequently perform TUR of the bladder neck as a separate short procedure. Such a strategy is significantly more radical than wedge resection of the dorsal bladder neck or the usually quite difficult enucleation of a small adenoma of 10–20 grams.

i) Severe Outflow Disorders Without Residual Urine

In these cases one is to some extent dependent on subjective information from the patient, although this may be objectively substantiated by urodynamic investigation.

As already pointed out in the above remarks on history-taking, a patient may have exceedingly severe symptoms and yet the general assessment will reveal little more of substance than a more or less enlarged prostate and some trabeculation of the bladder. Residual urine or back pressure on the upper tract cannot be demonstrated in such cases. The more measurement of urine flow tends to substantiate the patient's claims of severe urinary symptoms, the more inclined one should be to accede to his request for surgery. Even if there is no frequency of micturition but merely an extremely poor stream, as substantiated by urine flow measurements, there is a genuine indication to operate.

j) Bladder Tumors

In elderly patients bladder tumors are frequently an additional or chance finding during cystoscopic assessment of bladder outflow disorders. In all cases where an indication for transurethral treatment of a bladder tumor arises, we simultaneously resect the prostate or the prostatic adenoma, usually before treating the tumor itself. Such a procedure is of course only indicated for elderly patients, in whom the associated retrograde ejaculation is not a significant problem, and in younger patients in whom excision biopsy has revealed a carcinoma of the bladder of such shallow penetration as to be suitable for further endoscopic treatment.

The reasons for this regime are simple. In many cases the tumor is situated on the lateral walls of the bladder or close to the internal meatus. Its removal is less difficult if access to the side wall of the bladder is improved by preliminary prostatectomy. These patients will all require regular check cystoscopies, and instrumentation is far easier through a widely open bladder neck. As a result, patients will have less aversion to outpatient cystoscopy and are more likely to keep their appointments without reminders.

3. Rare Indications for Transurethral Surgery

In this section we consider uncommon indications for surgery which need to be borne in mind despite the rarity with which they arise.

a) Chronic Prostatitis and Prostatic Abscess

This indication is much debated and should be considered only a relative indication for proceding to surgery.

In chronic prostatitis surgery may turn out to be a blessing if immaculately performed on correctly appreciated indications. It is, however, mandatory to confirm the diagnosis by bacteriologic examination of ejaculate and expressed prostatic secretion, as well as by punch or aspiration biopsy. Ultimate perfection of operative technique is also required to guarantee the removal of inflamed and infected glands or areas of adenoma right down to the true fibrous capsule.

Prostatic abscess, on the other hand, is only then an indication for transurethral surgery if it lies close to the urethral lumen. Preoperative cystourethroscopy will easily confirm this, since the abscess may be seen bulging into the lumen of the prostatic urethra. On the other hand, in cases where rectal palpation reveals a perhaps fluctuant mass bulging into the rectum, drainage through the perineum is to be preferred.

Subsequent resection of the abscess cavity, i.e., of an area of chronic prostatitis, may still be performed at a later date if required.

This disease has recently become extremely rare. Ten or twenty years ago we saw up to five cases of abscess a year, now a single case may be separated from the next by several years. Pyogenic prostatitis is also on the decrease.

b) Prostatic Tuberculosis

This disease has also become so very rare as to be mentioned here purely for the sake of completeness. In the 1940s and 1950s it was an unusual but well-recognized condition with an incidence of several patients per year. Surgery is mainly indicated where obstructive symptoms are dominant. A preoperative period of high-dose chemotherapy is mandatory.

c) Multiple Prostatic Calculi

Only in the presence of obstructive symptoms and/or where the calculi form a nidus of inflammation or microabscesses does this disease represent an indication for adenectomy. Microabscesses may be diagnosed from the clinical picture, rectal examination and a copious purulent discharge on forceful palpation of the gland. Radiologic demonstration of duct ectasia is seldom successful (see Fig. 58).

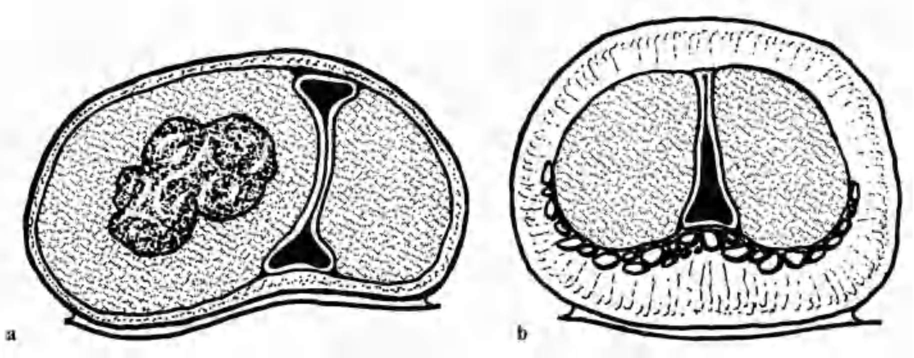

Fig. 58a, b. Diagrammatic cross section through the prostatic urethra in midorgan. a Large abscess of the left lateral lobe enlarging the latter and shifting the urethral cleft to the right. Obvious protrusion of the spherically enlarged lobe into the urethral lumen. **b** Position of prostatic calculi between adenoma and true capsule. These calculi are concretions formed within the glandular ducts of the prostate proper and concentrated in the periphery by enlargement of the adenoma. If the calculi are sizeable they become palpable rectally. Their visualization during resection proves that the margins of the capsule have not been exceeded

In the majority of cases asymptomatic prostatic calculi are not themselves a true indication for operation, merely a surgical obstacle. The techniques involved in these unusual types of resection and the way in which such rare indications may arise are further discussed in Chap. H.

4. Indications for Transurethral Prostatectomy

a) Prerequisites of the Surgeon

That the indications for this procedure are largely dependent on the technical ability of the surgeon became apparent even in the early years in which the guidelines for transurethral prostatectomy given in books by NESBIT and BARNES (both 1943) made this operation part of the general urosurgical repertoire in the USA. To this extent transurethral procedures are no different to those in other branches of surgery. No sensible or conscientious surgeon would operate on a cerebral tumor unless he had undergone an adequately long neurosurgical training of sufficient standard. One can imagine other examples ad infinitum.

The same is true of all transurethral surgery. Years of training are required before a surgeon should carry out this operation on his own unless the procedure is to be far more hazardous than open prostatectomy by the retropubic or transvesical route. The pioneer days when everybody *tried* his best are behind us.

A numerical estimate of technical ability is easily made. In transurethral operating units, records are routinely kept of operating time, irrigation fluid consumption, blood loss and total specimen weight in grams. These data provide a good measure of a given surgeon's abilities. For this purpose operating time should be divided into two parts:

1. The time required for removal of the tissue bulk
2. The time required for definitive hemostasis

The quality of hemostatic technique may be reliably estimated by two further factors:

1. The volume blood loss is an indicator of the surgeon's ability to close bleeding vessels as soon as they are cut, *during* the first phase.
2. The degree of hemostasis at the end of the procedure is evident from the appearance of the irrigating fluid.

According to an old rule, which I believe still to be valid today, the duration of surgery should not exceed one hour. If a young urologist is capable of resecting half a gram of tissue per minute, a 20-g adenoma should be resectable within the hour. Forty minutes are thus available for resection, and a young surgeon may require all of the remaining 20 min for definitive hemostasis. The blood loss during such a procedure should not exceed 200 ml. Since an experienced surgeon always supervises the trainee through a teaching attachment, these latter 20 min are perhaps a somewhat generous estimate allowing for small corrections to be carried out at the behest of the instructor.

As a gradual increase in speed during the first phase of the resection (without an increase in blood loss) testifies to the surgeon's increasing competence, he may be entrusted with operations on larger glands.

A highly experienced surgeon is capable of removing 100–130 g of tissue in an hour, including final hemostasis. In this case the first 50 min are devoted to tissue removal and concurrent hemostasis, and the remainder is for careful final hemostasis and cleaning of the resection cavity. Such a degree of practice is naturally only attained after a large number of operations and requires a high degree of technical dexterity, a factor well known to anyone with extensive experience in the training of young urologists.

Taking the example of a surgeon who removes 20 g of tissue in one hour, it may be seen that he is capable of successfully treating 30–40% of all patients requiring this type of operation for a bladder outflow disorder. Normally a surgeon's manual dexterity increases with time. With increasing experience he will feel able to resect larger adenomas without fear or trepidation. The level to which his abilities rise depends not only on individual talent but also on his enthusiasm for the procedure. If he has trained in a unit where the procedure is practiced with technical perfection, he is likely to have seen extremely high-risk patients come through the operation with flying colors and leave hospital a few days later in the usual fashion. This is usually adequate motivation for him to want to learn to emulate his masters.

All these considerations determine the indications as appreciated by an individual surgeon. This naturally requires true and honest self-criticism. It is of little or no service to the patient if a surgeon embarks on an adenoma too large for his technical ability and finally just about achieves a palliative resection. The days are over when transurethral operations were "a one-eyed art without a witness" (W. HEYNEMANN). The master can watch his apprentice's every step and vice versa. Fiberoptic teaching attachments have greatly contributed to this state of affairs.

This discussion of the personal element in the indications for TUR has, with good reason, been detailed, and in summary it may be said that every surgeon must know his limitations and should never attempt an operation beyond his abilities.

b) Early Surgery

This term denotes the concept of operating on a patient at a time when surgery represents only an insignificant hazard to him. To put it simply, but also crudely, the patient undergoes surgery at a stage in his disease when his symptoms are still so slight as not in themselves to represent a rigorous indication. The patient is nevertheless advised to undergo surgery at an early stage because of the greatly reduced risk, and because he will thus avoid an unpleasant waiting period. This notion is seductive as long as all goes well. However, when complications arise it becomes deeply depressing to have been responsible for advising a fellow human being to have an operation which was not strictly required. On the other hand, patients who have waited for several years with pronounced symptoms and finally decide in favor of surgery may often be heard to ask postoperatively: "Why didn't you try to persuade me harder all those years ago?"

These are borderline cases to which there is no patent solution such as exists when surgery plainly is or is not indicated. There will always be a no-man's land in which the decision for or against surgery depends on experience, manual dexterity and quality of aftercare, but one should remember that the personality of the surgeon himself is paramount in determining his willingness to take a risk or his caution in not doing so.

Finally, a number of other factors also play a part. A patient with only early symptoms who is travelling to an area with a poor standard of medical care should, for example, be rather more strongly advised in favor of surgery than one who lives in a town with modern transport facilities and virtually opposite the hospital, where he can be admitted immediately should he deteriorate or go into acute retention.

In this connection it should also be pointed out that the balance between indication and contraindication is nowadays significantly different to the situation of 30 or 40 years ago. In those days the operative mortality for this operation was 5–8%, whereas most units nowadays achieve a figure in the region of 1%, and often significantly less. This substantial reduction in the hazards of operation thus justifies a lower indication threshold.

c) General Indications for Transurethral Resection

If the operator requirements are met, any adenoma up to a given size may be removed transurethrally. The dividing line is better defined in terms of the contraindications.

5. Contraindications and Limitations to Transurethral Prostatic Adenomectomy

None of the following contraindications should be regarded as absolute. They are relative and under proper conditions and with the right precautions transurethral resection may nevertheless be carried out in their presence.

a) The very Large Adenoma

What was said in the previous section about operator competence is largely relevant in this connection. Despite the highest degree of technical ability, however, there are good reasons for setting reasonable limits.

1. The duration of the operation and the quantity of tissue removed are closely related to the incidence of urethral stricture. Unless the gland is approached by perineal urethrotomy the likelihood of stricture increases with the weight of tissue removed and the duration of the procedure.

2. Blood loss is directly dependent on the amount of tissue removed. Even with complete mastership of the Nesbit technique (see page 247) a minimum blood loss cannot be avoided, since hemorrhage not only depends on good or poor surgery but is also related to the length of the operation and the area of tissue from which continuous venous bleeding occurs.

3. A similar direct relationship exists for the entry of irrigating fluid into the circulation.

4. Resection should be carried out in a single session. The patient is certainly better advised to undergo supra- or retropubic prostatectomy in a single session than to be subjected to two or three transurethral resections of too large a gland just to serve a principle.

5. Finally, the transurethral method of operation is not an end in itself nor is it any form of artistic activity. It is far more one of a series of methods for the removal of a prostatic adenoma. Particularly in the case of large adenomas, the objective dangers increase rapidly for both forms of operation, open surgery or TUR. In terms of operative stress to the patient it is therefore no doubt better to set reasonable limits. We have decided on a value of 70–80 g, although the gland is not infrequently incorrectly estimated, with the result that adenomas in the region of 100 g or slightly over end up being removed transurethrally (and significantly smaller ones transvesically!).

b) The Markedly Protuberant Mobile Median Lobe

BAUMRUCKER (1968) has described this as a contraindication. Once again, the considerations of the previous section are largely true in this connection. The median lobe would have to be of really considerable size to become a significant contraindication to transurethral resection. It is precisely predominant median lobes in the presence of insignificant lateral lobes that are so easy to remove, since the bulk of hyperplastic tissue arises from the floor of the prostatic capsule. It is, however, true that removal of the endovesical portion of such an adenoma requires a special technique (see p. 233). The risk that larger pieces of the median lobe may be separated from their point of attachment and fall back into the bladder is not a specific feature of this form of hyperplasia and arises in any extensively intravesical adenoma. We have never experienced difficulty in the removal of large, free-floating lobe fragments, since they are easily withdrawn into the prostatic capsule and broken up there (see Fig. 166).

c) Bladder Calculi

The coexistence of a bladder calculus and prostatic adenoma is not infrequent. The decision between a transurethral approach to both lesions, suprapubic cystotomy for removal of the stone with later transurethral resection and thirdly a suprapubic approach to both lesions depends on a variety of factors.

α) Endoscopic Approach to Calculus and Adenoma. This is the most common procedure. An experienced surgeon can remove calculi of up to 3 cm diameter in 15–20 min, including the time required for evacuation of debris. There then remains adequate time for the resection of a 30–40 g adenoma. This upper limit should only be exceeded by a highly experienced surgeon.

β) Cystotomy for the Calculus and Transurethral Resection at a Subsequent Date. In special cases where a large calculus coexists with a small adenoma (transverse bar, bladder neck fibrosis), the least invasive procedure for the patient is removal of the stone by cystotomy with resection of the bladder neck approximately a week later, when the bladder wound has healed. We inevitably choose this course of action if particularly large calculi completely fill the cavity of the bladder and compress the ureteric orifices, causing upper tract obstruction. A quick cystotomy under epidural, or even local anesthesia is well tolerated even by uremic patients. When the bladder wound has healed and renal function has improved, the bladder neck obstruction may be dealt with as a separate procedure.

γ) Cystotomy and Prostatectomy as a Single Procedure. This combination is indicated whenever calculus and adenoma are both large, i.e., in all cases where the limits given under Sect. α) are exceeded.

d) Bladder Diverticulum and Prostatic Adenoma

The coexistence of these two pathologies also requires that therapy be correctly tailored to the individual situation.

α) Large Diverticulum and Bladder Neck Fibrosis. If the diverticulum is large but the obstacle at the bladder neck small, it is preferable to deal with the diverticulum prior to any procedure on the bladder neck. When the bladder has healed, the bladder neck may be resected in a separate event. The reason for this procedure is that enucleation of very small adenomas is often difficult and incomplete, while wedge excision of the dorsal bladder neck component is insufficient. The sequence (diverticulum first, bladder neck second) is important, since the separation of large diverticula is rendered difficult by a previous cystitis and, furthermore, the extraction of resection chips from one or more diverticula may be time-consuming.

β) Multiple Diverticula. Multiple small diverticula are often unsuitable for operative treatment. In these cases resection of the bladder neck obstruction is not infrequently successful in securing regression of the diverticula.

e) Bladder Diverticulum, Bladder Calculus, and Prostatic Adenoma

This combination is rare but always associated with difficulties in transurethral surgery, since litholapaxy is made difficult by the calculus or calculi disappearing into the diverticula in the same way as resection chips. Wherever the patient's general condition permits, a suprapubic approach should be chosen. This policy may of course change if diverticulum, calculus and adenoma are small. Under such circumstances a "customized" strategy is required.

f) Urethral Stricture

This pathology does not in itself represent a contraindication to transurethral surgery, so long as a filiform bougie may be passed and the urethra dilated enough to accept the Otis urethrotome, i.e., to 18 Ch. Following Otis urethrotomy – which should always be generous (to over 35 Ch!) – transurethral resection may be carried out.

An exception are cases in which dilatation leads to recurrent inflammatory change and profuse secretion from the urethra. Such a strategy should equally be abandoned wherever paraurethral cellulitis or even abscess occurs. In this case one may either rest the bladder by suprapubic catheterization and await regression of the inflammatory process with a view to subsequent urethrotomy under vision (SACHSE). Alternatively one may bypass the stricture altogether and carry out transurethral resection via a perineal urethrotomy, reserving the solution of the stricture problem for a later date. In younger patients it is worth considering whether the stricture should be treated by a reconstructive operation once prostatectomy has been completed.

g) Paraurethral Abscess During Preliminary Catheterization

This may delay operation but does not render it impossible. Suprapubic catheterization is performed and resolution of the infection awaited. Since the duration of postoperative catheterization is considerably shorter following TUR than after supra- or retropubic prostatectomy, we prefer this method for such cases.

h) Unusually Short Suspensory Ligament of the Penis

This contraindication only becomes apparent when instrumentation is attempted. In pronounced cases it may be necessary to bypass the anterior urethra by perineal urethrotomy. If forceful instrumentation is carried out, a urethral stricture at the penoscrotal angle may be anticipated.

i) Large, Irreducible Hernias

These may represent a considerable difficulty by markedly inhibiting excursions of the instrument, unless the obstacle is once again circumvened by perineal urethrotomy and the scrotum elevated by suitable strips of broad plaster. A similar situation may arise in extremely obese men whose penis is completely retracted into the pubic fat pad and scrotum. In such cases an initial attempt should be made to introduce the instrument in the usual way, and perineal urethrotomy may be undertaken if the instrument is not adequately mobile.

j) Epididymitis and Severe Urinary Tract Infection

Both these complications are contraindications to any procedure, and their resolution must first be achieved by appropriate drug therapy. There is a solitary exception: patients with infected urine and bladder calculi may not tolerate indwelling catheterization. They frequently suffer continuous bladder spasm refractory to any pharmacologic attack. In these cases early operation under high-dose antibiotic cover is the best and most rapid solution. In all cases of preoperative epididymitis operation should be delayed until the induration is largely resolved. Epididymectomy and contralateral vasectomy is advisable.

k) Ankylosis of One or Both Hip Joints

This may represent an absolute contraindication to transurethral resection, simply because it is virtually impossible to pass the instrument, and even if one succeeds in this, movement may be so limited in all directions as to render a proper operation impossible. In a few cases the hip joints may be slightly flexed in an upward direction, and the operator then sits beneath the patient. Such an approach should not, however, be achieved by force and is only appropriate to particularly urgent indications.

l) Prostatic Carcinoma Amenable to Radical Surgery

In such cases any transurethral procedure is contraindicated because of its inadequate radicality.

6. Limits of Operability[1]

a) Initial Considerations

Whenever the initial assessment suggests that a patient requires surgery, it must still be decided whether he can be expected to tolerate it. In this section those factors will be discussed which may affect a patient's general operability. Difficult decisions may arise where the choice is between condemning the patient to a life with an indwelling catheter or unrelenting dysuria on the one hand or both patient and surgeon accepting the unusually high risk of an operation under unfavorable conditions on the other. Wherever possible, a patient should be fully informed of the situation and be actively involved in decision making as far as his mental powers allow. In high-risk cases I make a practice of discussing the matter with the family whenever possible, as I find it unacceptable for the doctor alone to bear the responsibility of the decision, just as it is unacceptable for the patient to be entirely excluded.

Conditions relating to other fields of practice naturally require a specialist opinion. Occasionally a decision can only be reached in consultation with a number of specialists, and in addition to these detailed considerations weight should also be given to the surgeon's overall impression of the patient in the light of his experience.

Such factors as the patient's general activity, his will to cooperate and recover, his joie-de-vivre and wish to remain alive, also his appetite and in short the sum total of his expressions of vitality may, in the end, be of more decisive influence than any laboratory investigation.

The following is a summary of the more important complications which may be anticipated in elderly people together with a few hints on their individual significance for the selection of surgical candidates.

b) Cardiovascular Disease

This is frequent and only represents a contraindication if proper preliminary medical treatment is unable to achieve significant improvement.

Surgery is ill-advised in the presence of irremediable or poorly correctable cardiac failure or in the presence of some types of malignant hypertension giving rise to cardiovascular complications despite maximum hypotensive therapy (cardiac dysrhythmias, cerebral hemorrhage). The increased bleeding tendency of hypertensives may also represent an operative difficulty.

Patients with external pacemakers do not represent risk patients since pacemaker function and the interaction of pacemaker- and cardiac rhythm are easily checked by ECG and regular pacemaker clinic attendances.

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[1] I am particularly indebted to Professor W. Sack for revising and in part considerably extending this section. For more than 10 years he has been Consultant Physician to our department and makes a point of seeing all our patients coming to surgery both before and after their operation. In view of his appointment to the II. Department of Internal Medicine in Munich (Klinikum rechts der Isar) he is eminently predestined for such a task

Any cardiac condition may require an increased degree of cooperation between urologist, physician and anesthetist.

c) Pulmonary Disease

Chronic bronchitis, emphysema and bronchial asthma are the commonest diseases of the respiratory system. Chronic purulent bronchitis responds excellently to intubation and bronchial aspiration during anesthesia, and for such cases ventilation is to be preferred. For emphysematous patients, however, we prefer to maintain spontaneous respiration and employ epidural anesthesia. Neither condition is commonly a contraindication. Severe bronchial asthma is another matter, and we frequently experience extensive postoperative problems. Anesthesia itself presents no difficulties, but the postoperative period is fraught with danger, particularly in patients who depend on high doses of steroids. Problems arise with respiratory failure and severe urinary tract infections despite early removal of the catheter and high-dose antibiotic cover, and it is often impossible to avoid secondary infection of the lungs. It may, however, be that these experiences represent a coincidental cumulation of poor risk candidates since we have only had a small number of such patients.

d) Cerebrovascular Disease

Advanced stages of this disease may represent an absolute contraindication (even to cryosurgery), the danger lying not in the operative but in the postoperative phase. Patients generally withstand operation well, but on the second or third postoperative day they begin to become agitated and confused. Motor agitation is particularly difficult to control and may require sedation despite the availability of a special nurse. Patients often pull out their catheters, usually violently, and occasionally this results in urethral trauma. They have bizarre fantasies, are unaware of their surroundings and frequently fail to recognize their relatives. This period may persist for 2–3 weeks before they return to their normal condition, and the assistance of cooperative relatives is of the utmost value.

For this reason particular attention should be paid to preoperative diagnosis of this type of condition. This may be quite difficult, since some patients have a considerable instinctive ability to conceal their true state. Day-to-day language is composed to such an extent of stereotype expression that it may be some time before a deterioration of mental agility and intellectual capacity becomes apparent. Operating on such patients therefore always entails a very considerable and not easily estimable risk. Death may often result from bronchopneumonia with or without pyelonephritis and in the presence of complete cerebral decompensation.

Even if patients recover from the procedure and regain a proportion of their previous intellectual ability, there is often a residual defect with permanent incontinence of nonanatomical causation.

e) Renal Insufficiency

Interestingly enough, even patients with severely impaired renal function tolerate transurethral resection extemely well. Renal failure as a result of prolonged occult chronic urinary obstruction often responds favorably to a period of decompressive catheterization. However, an end-stage in this improvement is reached after 3 or perhaps 6 months. The raised serum creatinine may be temporarily reduced by a forced fluid intake, but at the end of intravenous therapy it will gradually drift back to its original level. Never a year passes in which we do not operate on a few such patients with a serum creatinine of 7, 10 or even 15 mg%, and yet their postoperative course is no different from that of other patients. Not infrequently they have had an indwelling catheter for several years because of an unfounded fear of postoperative renal failure.

f) Liver Damage

Only the most severe disorders prevent operation. Any patient in a stable condition (i.e., without rapidly progressive disease) may be operated on without additional risk. In view of the statistically documented increase in liver disease, advising physicians not infrequently have to suggest delay and occasionally cancellation of an operative procedure because decompensated cirrhosis or chronic inflammatory disease of the liver with acute exacerbations excludes anesthesia. Temporary transfer to a medical ward and extensive suppression of the inflammatory process may improve the preoperative situation.

g) General Decrepitude

Such patients are not characterized by any particular dominant abnormal physical findings. Nevertheless, in the light of experience they represent poor risks. Their life is at a low ebb, they exhibit little motor activity, but are fully orientated. They eat little and doze a great deal. They tend to minimize their urologic symptoms, including retention with overflow. Laboratory values are frequently normal and vital functions intact.

Nevertheless these burnt-out people are *not* suitable for surgery. They accept permanent urethral or suprapubic catheterization for retention, high residual or incontinence with fatalism and hardly seem to notice it, whereas operation shortens their lives. For the totally disorientated patient who repeatedly pulls out his indwelling catheter there is often no alternative to intermittent catheterization.

Personally, I am extremely doubtful whether cryosurgical treatment offers any improvement of this situation, since the postoperative requirements are identical to those of diathermy resection.

h) Mental Subnormality and Psychosis

Although subnormal patients are frequently good-natured and will agree to anything, there are a variety of reasons for excluding them from surgical treatment. Even such a simple process as the relearning of micturition following prostatectomy requires a minimum of intellectual ability. These patients often remain incontinent postoperatively, and in the first phase of the postoperative period they may behave like patients with cerebrovascular disease, not infrequently exercising violence to remove their balloon catheters.

With psychotic patients the situation is different. In this age group we are mainly concerned with depression and the decision on the indications for surgery should only be reached in close consultation with a psychiatrist to whom the patient is well-known. Discussions with the family may also be helpful in such cases.

Patients should not be operated on during acute bouts of depression, and a remission should be awaited, although surgery itself may precipitate a deterioration. Since a proportion of antidepressants exercise a paralytic effect on the detrusor muscle, a large proportion of these patients exhibit a significant and rapid worsening of their urinary symptoms during attacks of depression.

i) Inoperable Carcinoma in Other Organs

Surgery should be reserved for those patients whose expected survival is at least a year by conservative estimate. This applies particularly to the elderly whose carcinoma of the rectum, stomach or bronchus often progresses extremely slowly. Colostomy patients in particular may find a permanent indwelling catheter an intolerable additional burden.

In such cases a decision should be reached in discussion with the practitioner treating the patient's principle complaint, and with the family, wherever the patient himself is not aware of his condition.

The same is true for chronic leukemias which often run a rather indolent course in the elderly.

j) Coagulation Disorders

Only a proportion of those disorders of hemostasis liable to complicate or indeed prohibit operative urologic procedures are amenable to preoperative diagnosis and treatment. Thromboembolic disease requiring anticoagulant or fibrinolytic therapy is common, and there is nothing out of the ordinary about myocardial infarct and pulmonary embolus survivors, especially among male patients.

Laboratory investigation is required of the total clotting time, of individual clotting mechanisms and of fibrinogen titers, in order to monitor the return to normal following withdrawal of anticoagulant therapy. Only thus may hemorrhagic complications during and after surgery be avoided. Furthermore, postoperative infections and severe sepsis carry their own risk, particularly in the elderly, of consumption coagulopathy – changes in the coagulation and fibrinolytic system due to entry into the circulation of endotoxin from a septic focus.

Frequent estimation of all coagulation parameters with appropriate therapeutic action and observation of the patient in an intensive care unit are mandatory.

The clinical entity of isolated hyperfibrinolysis is extremely rare but should be considered among the causes of any postoperative coagulation problem.

The care of any of these disorders demands the availability of a coagulation laboratory day and night, 7 days a week.

k) Diabetes Mellitus

This disease is not a contraindication to surgery. The most severe cases may require a brief period of postoperative observation in an intensive care unit. Every case requires close cooperation with the patient's physician.

Once again, a 24-h laboratory service is essential for the early diagnosis of deteriorating diabetic control.

l) Obesity

Early mobilization of these patients after surgery is of paramount importance, since their tendency to thromboembolic problems is best avoided by frequent and early ambulation in addition to heparin and Hydergine prophylaxis. The obese are often, by their very nature, somewhat inert and have a low exercise requirement. However much they moan and groan, therefore, they must be mobilized and made to leave their beds. If surgery is definitely indicated but is not urgent, it should be made conditional on losing weight. The latter in itself frequently improves the urinary symptoms. On account of the poor healing qualities of fat, transurethral surgery is the method of choice, even for large adenomas.

m) Thrombophlebitis, Varicose Veins

In these patients we wait for the regression of acute inflammatory episodes. Early postoperative mobilization is mandatory.

III. Preoperative Treatment

Preoperative preparation and assessment are often carried out during the same period of time. They are dealt with separately in this book for purely systematic reaons which have nothing to do with clinical practice. As far as possible, preliminary assessment and preoperative treatment should be on an outpatient basis before admission to hospital, so as to save the patient valuable time and considerable hospital expense. Only a small proportion of urologic workup requires hospital admission, e.g., the treatment of severe infection or of renal failure and uremia following chronic retention.

1. Draining the Bladder

The atonic bladder with a large residual volume (above approx. 500ml) and of course all patients with overflow incontinence or acute retention require decompression of the bladder. This may be achieved by an indwelling catheter, intermittent catheterization or suprapubic cystostomy.

a) Intermittent Catheterization

This form of drainage procedure is useful when a patient has gone into acute retention but there seems some likelihood of re-establishing spontaneous micturition. It has the disadvantage that the patient must be catheterized at least thrice daily, and the advantage that appropriate aseptic conditions allow the avoidance of a urinary tract infection such as is certain to occur after several days of indwelling catheterization. In principle, a patient with acute retention could be operated on as soon as the appropriate preliminary investigations and preoperative treatment are complete, i.e., after 2–3 days if no serious medical or other special complications supervene. The patient's professional commitments or a lack of hospital beds prevent this, the patient may be tided over a short waiting period by intermittent catheterization.

Technical note: a fine Tiemann catheter (12–14 Ch) is preferred.

b) Permanent Drainage

Permanent preoperative urinary drainage is indicated whenever chronic retention has led to overdistension of the bladder and consequent atony, or if renal function has been impaired by backpressure of urine into the upper tract. All such patients should be treated by permanent bladder drainage prior to surgery, either to allow the restoration of bladder tone or to encourage the recovery of renal function.

α) The Dye Test. This process may be monitored either by repeated estimation of blood nitrogen levels, by the PSP test or, more simply, by "blue testing". Since restoration of upper tract tone usually goes hand in hand with recovering renal function, the time elapsing between the injection of 5 ml indigocarmine (0.02 g/5 ml) and the appearance of blue coloration in a bladder irrigation is a reliable measure of the degree of improvement in urine transport. Failure of blue dye to appear even after 20 min is strongly suggestive of a lack of improvement in real function and upper tract dilatation. If the dye appears in under 10 min, but only in weak concentration, cautions conclusions may be drawn as to the recovery of renal function, which should then be substantiated by serum creatinine estimation. Only if obvious blue discoloration is apparent in under 7–8 min do we proceed to repeat excretion urography, which then invariably shows a marked improvement in function and morphology of the upper urinary tract.

β) Indwelling Catheters. Indwelling catheterization is *one* alternative for continuous drainage of the bladder. Bilateral vasectomy should be performed at the time of catheterization. Despite an increasing tendency toward permanent drainage by suprapubic cystostomy, there are a number of indications for an indwelling urethral catheter:

1. Markedly obese patients with an abdominal fat apron
2. Patients suffering from large and enormous inguinal hernia
3. Patients with chronic exudative eczema and other dermatoses of the hypogastric region
4. Patients with coagulation disorders preventing even suprapubic needle puncture
5. The presence of a colostomy should lead one to consider the additional difficulty in proper hygiene
6. In markedly agitated and temporarily disorientated patients, repeated catheterization with a periodic need to replace an indwelling catheter is still preferable to the difficulties in maintaining the otherwise more practical suprapubic drainage route

γ) Slow Decompression of the Bladder. On occasion, a chronically overdistended bladder may show a tendency to react to sudden emptying by profuse hemorrhage. Slow decompression should therefore be routine clinical practice. We have occasionally had patients referred to us whose bladder has been suddenly completely emptied. A few of them developed surprisingly severe hemorrhage from a diffusely erythematous mucosa not unlike that of hemorrhagic cystitis. On occasions the hemorrhage was so brisk that we suspected some other cause of bleeding and undertook emergency cystoscopy which would not otherwise have been indicated. Such hemorrhage should be treated by continuous irrigation of the bladder until the risk of clot obstruction of the catheter is over.

δ) Immediate Decompression of the Bladder. This is the method of choice in acute retention and is employed by some in the routine treatment of chronic retention. For the reasons given above, I personally prefer slow decompression of the latter.

ε) Cystostomy. This may be performed either by formal operative cystostomy or by transcutaneous puncture. Formal suprapubic cystostomy is nowadays rarely employed, having been almost entirely replaced by trocar cystostomy. The latter may be performed in three ways.

1. Simple trocar cystostomy by nonballoon catheter. This has the disadvantage that some form of additional attachment of the catheter is required, since there is no balloon to hold it in the bladder. Its advantage lies in the absence of a side-slit in the trocar, so that no urine is extravasated on withdrawal of the stilette.

2. Suprapubic puncture cystostomy by Campbell trocar. The trocar described by CAMPBELL (1951) has a side slit allowing introduction of a balloon catheter into the bladder. Because of the risk of extravasation of urine from an overfilled and overdistended bladder we only employ this method if we ourselves are in a position to control bladder volume, e.g., when suprapubic drainage is established in the treatment of paraurethral abscess. In such cases a volume of 300–400 ml, depending on bladder capacity, is adequate to so extend the cave of Retzius that the extraperitoneal portion of the bladder becomes substantial.

3. The technique of trocar cystostomy (transcutaneous cystostomy). Unless chronic retention has so distended the bladder as to obviate any doubt that the distended bladder has elevated the peritoneal reflection, local anesthetics should first be aged to produce an intracutaneous weal, 1–2 fingers' breadths above the symphysis. A fine needle of approximately 10 cm length is then used to infiltrate the puncture tract with local anesthetic. The tip of the needle should thus enter the bladder and allow proof aspiration of urine. A small pointed scalpel is next used to make a skin incision of some millimeters length. Unless the patient is exceptionally obese the blade will reach the deep fascia and may be used to penetrate it. A sudden push thrusts the trocar into the bladder, the stilette is withdrawn and urine flows from the tube. A catheter, either of balloon or plain type is now quickly advanced through the trocar tube into the bladder. Inflation of the balloon and withdrawal of the catheter until the balloon is in contact with the anterior bladder wall are the final steps of the procedure. Plain catheters with a central opening must be adjusted for depth, according to the patient's stature, and in this technique it is preferable to introduce the catheter rather lower and to fix it by means of a skin suture tied around the catheter. As an additional precaution we attach a safety pin to the catheter, place a keyhole gauze swab above and below the pin and fix the entire dressing and catheter by means of additional adhesive strapping.

4. Suprapubic puncture by disposable catheter. In recent years a number of purpose-made, disposable instruments have become available that greatly facilitate suprapubic puncture. However, the tubes used in this equipment are considerably narrower than the usual catheters. For this reason the changing of tubes and conversion of the cystostomy to balloon catheter drainage is somewhat complex. On the other hand, this disposable equipment has considerably broadened the indications for suprapubic drainage.

5. Formal cystostomy. This may become necessary if previous procedures such as cystotomy or intraperitoneal surgery in the lower abdomen have made the behavior of the peritoneal reflection unpredictable. Adhesions may have fixed it so far caudally that attempted suprapubic puncture may enter the abdomen.

Formal cystostomy can be avoided in patients who require suprapubic diversion for a paraurethral abscess and whose urethra can or should no longer be catheterized if the bladder is distended by intravenous fluids and mannitol. It is then necessary to so sedate the patient as to prevent premature reflex voiding.

2. Vasectomy

a) Indications

Even if this maneuver is carried out prior to permanent indwelling catheterization, it cannot be guaranteed to prevent epididymitis and funiculitis, although it is likely to reduce their incidence. It would seem that urethral organisms are capable of lymphatic spread. Prophylactic vasectomy occasionally appears justified by the phenomenon of funiculitis involving the proximal spermatic cord as far as the point of interruption, where the process terminates in a bulb-like infiltration.

Extreme scrotal edema, unilateral or bilateral hernia and marked obesity with pronounced subsumption of the scrotum into the inguinal fat-fold may render vasectomy unusually difficult.

In such cases vasectomy is not easily performed through the customary 1 cm skin incision in the scrotum; either an inguinal approach to the cord or a more extensive scrotal incision is then required. The procedure should then be carried out under general or epidural anesthesia. It is indeed worth considering dispensing with vasectomy altogether and accepting the risk of epididymitis. Should the latter occur it may still be treated by early epididymectomy and contralateral vasectomy. Bilateral inflammatory change in the epididymis is rare, but does occur.

b) Technique

The operation may be extremely simple, but is on occasion quite taxing. Vasectomy is always easy if the scrotum is lax and consists chiefly of pendulous skin without extensive wrinkling by the cremaster muscle. This minor procedure is rendered less easy, but by no means truly difficult, by taut wrinkled scrotum drawn up toward the trunk by an active cremaster. In either case careful palpation of the cord is of prime importance, making possible the displacement of possible edema. With a little dexterity the vas deferens is easily isolated and firmly grasped between thumb and index finger of the left hand. Only then is 2% local anesthetic injected immediately under the skin as well as cranially and caudally along the course of the vas. This helps to minimize the dragging pain sometimes experienced during delivery of the vas. At this stage finger grip should be replaced by a towel clip, capture of the vas derens confirmed and a small incision, not greater than 1 cm, made along the cord parallel to its axis. The vas is then grasped with forceps and freed of all fascial layers, a process greatly facilitated by a small incision into the adventitia of the vas. The duct is now elevated out of the wound and central and peripheral ligatures applied 3–4 cm apart. Subcutaneous and skin sutures complete the procedure. Hemostasis is rarely required if the initital incision was made through an area of scrotal skin devoid of superficial veins.

3. The Treatment of Urinary Infections

If urinary infection is apparent on initial assessment, it should be energetically treated in the run-up period to surgery. Patients whose preoperative treatment does not require an indwelling catheter must be considered separately from those requiring catheterization because of renal failure or bladder atony. *Uncatheterized* patients should be treated according to the severity of infection and in the light of bacteriologic sensitivity studies. If there are fewer than 10^4 organisms/ml, no treatment is required. Where the bacteria count lies between 10^4 and 10^5, treatment should be at the mucosal level by an agent achieving good urine levels. Even if there are more than 10^5 organisms/ml, therapy should take account of the severity of symptoms and number of pus cells. If the latter are numerous, one should not hesitate to prescribe a broad spectrum antibiotic at a dose of 3 g per day and arrange to operate at the earliest possible date, so that surgery will be covered by this treatment.

Such a regime is particularly strongly indicated if a tiresome organism such as Klebsiella, Pseudomonas, Proteus or a resistant Coliform is cultured. In these cases, which frequently require treatment with several agents in combination, antibacterial therapy should be instituted 3 days prior to surgery and continue without interruption well into the postoperative period.

A preoperative exacerbation of infection in patients with indwelling catheters may usually be adequately treated by a sulphonamide or furantoin derivative. Specific curative therapy is only required under the circumstances described for uncatheterized patients.

It goes without saying that intercurrent infection with severe symptoms, such as epididymitis, funiculitis or acute fibrinoid cystitis with bladder spasm demands energetic antibacterial therapy. Both severe urethritis and paraurethral abscess, the latter nowadays rarely seen except in patients in poor general condition, require the exhibition of antibiotics in high doses. Paraurethral cellulitis should be treated prior to formation of an abscess by removal of the indwelling catheter, local instillation of an antibiotic gel (viscosity, long local duration of action) and by suprapubic diversion, as described above.

4. Balanitis and Inflammation of the Prepuce

The patient with an indwelling catheter and a tight preputial recess is particularly prone to balanitis and inflammatory change of the prepuce. Since prophylactic circumcision is nowhere near as commonplace in Europe as in the Orient or the USA, we not infrequently come across such problems. Although circumcision represents a simple form of treatment, the bacteriologic situation should nevertheless be investigated and the appropriate therapy of fungal or yeast infections initiated.

5. Chance Finding of Urogenital Tract Tumors

Under these circumstances priority should be given to removing the more dangerous carcinoma, e.g., a hypernephroma or ureteric tumor, in order to proceed to prostatectomy after a suitable recovery period.

6. Strictures of the Urethra

Stricture patients with an adequate urinary flow who do not require indwelling catheterization need no special treatment prior to admission. Once they are in hospital, they may be treated by daily recatheterization with indwelling catheters of increasing size. The urethra may then be calibrated at the time of operation by introducing the Otis urethrotome (16–18 Ch). Less rigid strictures may be left alone until the time of operation; they are then incised with the Otis knife prior to introduction of the resectoscope. The same procedure may be adopted with tougher strictures, but preoperative urethrotomy under vision is preferable. This may then be followed by a transurethral resection.

7. Preoperative General Medical Preparation

In nearly every clinic this is undertaken in close consultation with an advisiing physician. Once again, investigation and preliminary therapy are closely linked and based on the appropriate pathologic findings. There is rapid interplay of diagnosis and treatment.

Our system, whereby our own consulting physician sees every patient in the unit, has stood the test of time. Such close cooperation means not only that he comes to recognize the specific problems of our type of patient, but also that he remains in touch with the patients postoperatively. He thus acquires an accurate sense of the severity of the procedure and is able to give valuable advice when the arguments for and against surgery in the high-risk patient are being considered. He will advise additions to the routine laboratory workup and has access to ECG and chest X-ray facilities, enabling him to request further investigations.

Wherever organizational considerations permit, the physician should be available at the time of preliminary outpatient assessment. Once a patient is admitted he will thus be seen by a physician to whom he is accustomed and whom he will identify as "his own."

Particular importance attaches to electrolyte estimations in all cases of renal impairment. Any significant degree of renal failure will require appropriate modification of intravenous fluid and elctrolyte therapy.

IV. Preoperative Endoscopy

1. General Considerations

As already discussed under Sect. I.2.c), we have dispensed with outpatient cystoscopy for the majority of cases. Our aim is to spare the patient unnecessary duplication of examinations, as enough is usually already known about the morphology and extent of the bladder neck obstruction on the basis of investigations such as excretion urography, cystourethrogram and rectal palpation. There is chemical data on renal function and radiologic information on the upper urinary tract. The advising physician has already clarified the question of operability and the indications for surgery will have emerged from the workup so far. There are thus extremely few patients in whom the question of retropubic or transurethral resection is still open at this stage. We have adopted the practice of carrying out cystoscopy and bladder neck examination under the same anesthetic as the definitive operation.

2. Introducing the Instrument

a) Surgical Anatomy

The urethra presents both physiologic narrowings which may resist instrumentation and curvatures which need to be borne in mind.

Before the technique of Otis urethrotomy became generally accepted, there was in Germany a widely held belief in the need to dilate the urethra prior to passing the resectoscope. Daily recatheterizations with catheters of increasing size were used to dilate its lumen in 2-Ch steps to a caliber 2 Ch greater than that of the instrument. Only then would the resectoscope be passed. I remember quite clearly that FLOCKS refused to operate transurethrally on any patient who had not been catheterized for at least 2 days prior to surgery.

Beside this gradual method there is also that of rapid dilatation of the urethra by metal sounds to a caliber of 30 Ch or more. Since this frequently painful procedure was preferably carried out under general anesthetic, such urethral dilatations were usually done immediately prior to resection. The latter method originated in the USA (whence it became popularized in Germany, but was for all this no more physiologic). Such dilatation to over 30 Ch is

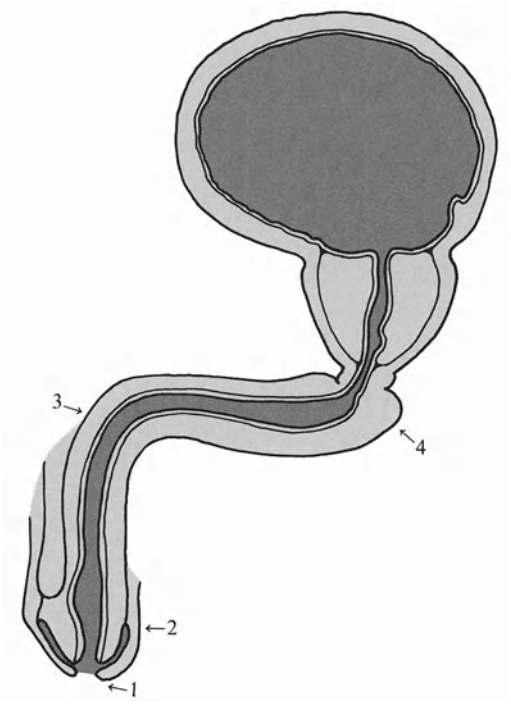


Fig. 59. Urethral narrowing. Physiologic variations in urethral caliber occur at specific sites. These regions are also the sites prone to traumatic strictures: (*1*) internal meatus, (*2*) transition navicular fossa to penile urethra proper, (*3*) penile urethra, (*4*) transition bulbar urethra to membranous urethra. (After ISAAC, 1959)

bound to cause urethral tears, even if carried out in 2-Ch steps – a fact of which one may convince oneself by passing the resectoscope under direct vision through a thus traumatized urethra.

The advantages of a clean cut by the technique of internal urethrotomy (EMMETT) are set out later (see Sect. IV.3).

b) Physiologic Urethral Constrictions (see Fig. 59)

α) The External Meatus. The external urethral meatus is of extremely variable caliber, a fact without clinical significance. Only in cases of true meatal stenosis may the urinary stream be impaired. Under normal circumstances the external meatus does not represent an obstacle to our standard 24-Ch resectoscope. If, however, the instrument will not pass this point spontaneously, a tapered dilator should under no circumstances be employed, since this is invariably associated with tears of the urethral mucosa and deeper layers. These small tears lead to meatal stenosis, as frequently occurs following the use of wide bore instruments with sharp-ended sheaths, and the reader is reminded of our comments on this subject in Chap. B. The shrouding of this sharp edge of

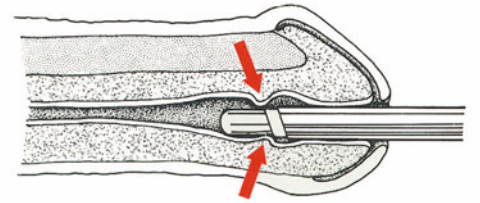


Fig. 60. Introducing the instrument with a standard obturator. The step-like transition between obturator and insulating ring may give rise to mucosal injuries. The point of transition from navicular fossa to penile urethra is particularly at risk, since there is a genuine change in caliber at this point

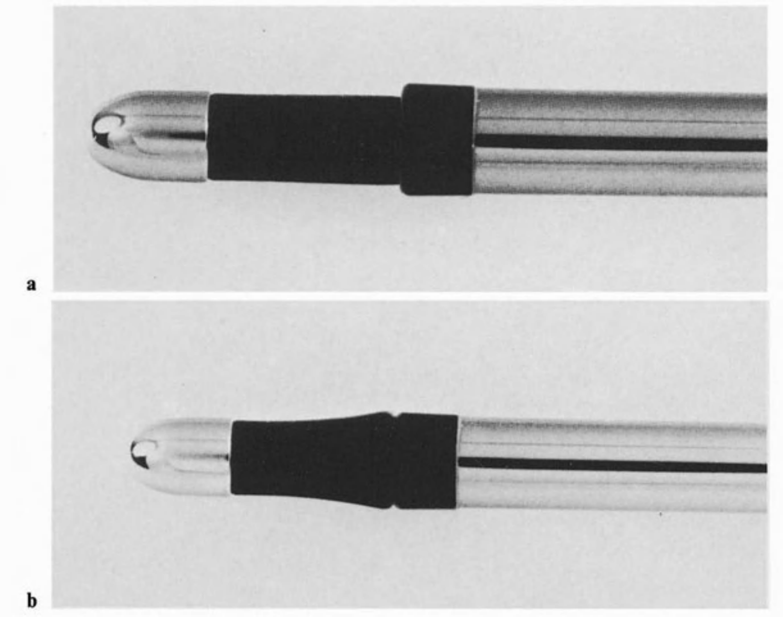


Fig. 61 a, b. Leusch cuffed obturator. a The step between obturator and resectoscope sheath insulating ring is clearly seen. **b** Rubber cuff of the obturator spread so as to completely shroud the sharp edge of the insulating ring

the instrument by the cuffed obturator of LEUSCH represents a significant contribution in reducing the stricture rate in this region of the urethra. Without the streamlining effect of this rubber cuff, the transition from the obturator to the sheath end acts as a gouge resulting in serious urethral injuries which regrettably enough frequently go unnoticed (Figs. 60 and 61). This region is, furthermore, particularly at risk since it is the point of collection of urethral secretions. The latter tend to penetrate mucosal tears and give rise to inflammatory change and subsequent stricture.

β) The Transition from Fossa Navicularis to Penile Urethra. At this point there is a marked change of caliber, as the broad fossa narrows into the penile urethra.

If the resectoscope sheath, the most dangerous part of which I have already discussed, is forcibly advanced at this stage, the same injury may occur as at the external meatus. The mechanism of injury may be accurately observed if the instrument is advanced to the point of resistance, the obturator then removed and the urethra observed through the electrotome telescope under running irrigation. The insulating ring of the sheath has ruckled up the mucosa at the point of transition from fossa to penile urethra so that it bulges in a fold into the lumen of the sheath. Further advancement would lead to multiple tears of which the outcome would be an iris-like stricture.

γ) The Penile Urethra. This part of the urethra is physiologically somewhat narrower than the remaining parts and is therefore liable to injury. Care must thus be taken with this region also. The sheath should be allowed to fall gently under its own weight into the bulb, once the urethra is well lubricated.

δ) The Transition from Bulbar to Membranous Urethra. This point once again represents a change in caliber between the extremely capacious bulbar and the proximal urethra as it narrows to pass the urogenital diaphragm. Although this latter region is usually extraordinarily elastic and fully expands during micturition, it is normally constricted by tonic contraction of the external sphincter muscle, as may be observed on any urethrocystogram film. When advancing the instrument blind toward the bladder one not infrequently feels some resistance which may be overcome by a slight change in direction. If the same method of observation is employed as has been already described for the fossa navicularis, one may once again observe folds of mucosa bulging into the sheath aperture. Under direct vision it becomes extraordinarily easy to pass this narrowing and advance the instrument, since one is then changing direction according to the true requirements rather than by feel alone.

c) Curvature of the Urethra

In all three curvatures are to be passed (Fig. 62).

α) Curvature at the Penoscrotal Angle. The fixed portion of the urethra at the transition between penile and intrascrotal urethra, at the penoscrotal angle, is usually overcome by elevation of the member under gentle traction.

β) Curvature in the Bulb. In this region the urethra loses its almost horizontal direction and rises steeply up behind the symphysis toward the bladder neck. This curve can only be overcome by lowering the instrument. All the special equipment designed to facilitate passage of this region (e.g., Timberlake obturator) is usually superfluous if only the external end of the sheath is lowered far enough. Since the fully introduced instrument will inevitably splint the urethra into a straight line, this process may be allowed to occur progressively during passage of the instrument. For the past 20 years we have used exclusively straight instruments and have never experienced difficulty in passing this region. The sole, extraordinarily rare obstacle may be an extremely short suspensory

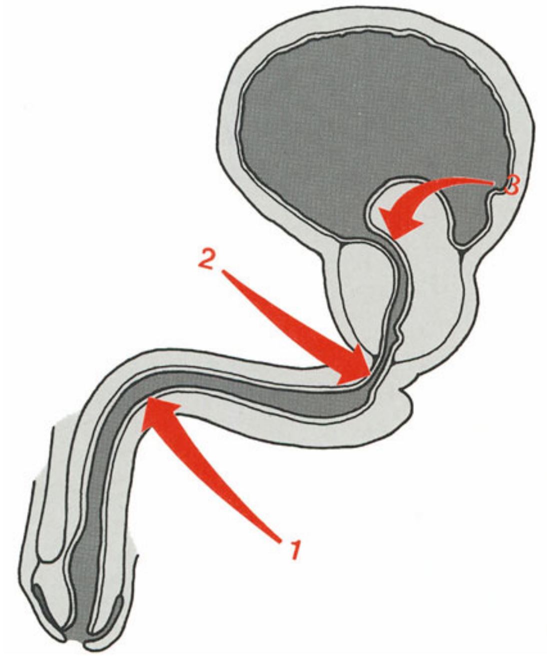


Fig. 62. Urethral curvatures. *1* Curvature at penoscrotal angle (easily straightened). *2* Curvature at the bulb. At this point the urethra rises up behind the symphysis. This curvature is easily overcome by lowering the instrument. *3* Curvature due to a large endovesical median lobe. This change in direction must also be compensated for by lowering the eyepiece of the instrument, a procedure occasionally giving rise to pain in the unanesthetized patient. Forceful advancement at this point may perforate the median lobe, which structure can always be manipulated away dorsally during instrumentation under direct vision

ligament of the penis, which prevents the penis being bent downward. We have already discussed this difficulty when considering contraindications, and a perineal urethrotomy may then be required. Once the instrument has reached the membranous urethra no further change of direction is necessary.

γ) Ventral Curvature of the Urethra Due to a Median Lobe. This third and final curvature is not invariably found, only occurring in the presence of a dorsoventrally bulging median lobe (Fig. 63). It may be a truly difficult obstacle to overcome in the unanesthetized patient, e.g., if a patient with painless hematuria is to be cystoscoped in the outpatient clinic. However, we have never failed to pass the instrument over the most protuberant median lobe during preoperative cystourethroscopy under general anesthetic, although it is fair to point out that we employ direct vision at the slightest difficulty during this final phase of instrumentation. It then becomes possible to lower the instrument as far as is required and to use the end of the sheath to somewhat depress the median lobe. The various aids designed for this maneuver, such as angled or hinged obturators, Tiemann Catheters passed through the sheath, etc. are obviated by passage under direct vision.

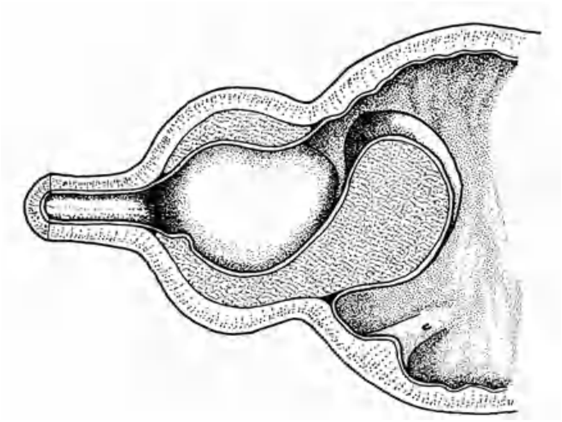


Fig. 63. Large median lobe with extensive protrusion into the bladder. This may represent a true obstacle to instrumentation, and is usually clearly seen on cystourethrography. The lobe represented here has a narrow base, easily confirmed by the mobility of the lobe. Care should be taken during its ablation so as not to separate a large fragment which will then float freely within the bladder. (See Chap. E.IV.5)

3. Aids to Passing the Instrument

a) Internal Urethrotomy with the Otis Urethrotome

α) Preliminary Considerations. The mistake most frequently made during instrumentation is the use of force, which will inevitably raise the stricture rate. The urethral lumen should therefore be adequately calibrated by urethrotomy. The rationale for this procedure is simple: instead of multiple uncontrolled tears in the mucosa and the subjacent corpus cavernosum of the urethra, a smooth sharp longitudinal cut is made in a predetermined direction (Fig. 64). This longitudinal incision subsequently epithelializes, albeit with the formation of a longitudinal scar. The straight band of scar tissue, however, seldom produces more than minimal narrowing of the urethra, whereas multiple tears distributed around the periphery give rise to ring strictures. A urethrotomy scar is seldom even visible at subsequent urethroscopy.

The work of EMMET and WINTERRINGER (1954) was therefore a fundamental contribution to the prevention of such strictures which would represnt a serious contraindication to transurethral surgery, could they not be avoided.

β) Technique of Otis Urethrotomy. The detailed procedure is a follows: The well-lubricated sheath is introduced into the external meatus. If it fails to pass this point spontaneously under gravity, no further attempt is made to pass the resectoscope. The Otis urethrotome is always at the ready and is immediately employed to incise the urethra in this region to 30 Ch. We base this procedure on the experience that the Otis incision needs to be 5 Ch larger than the diameter of the resectoscope. Since we never use an instrument greater than 24 Ch, even for the resection of large adenomas, the Otis urethrotome is set at 30 Ch but

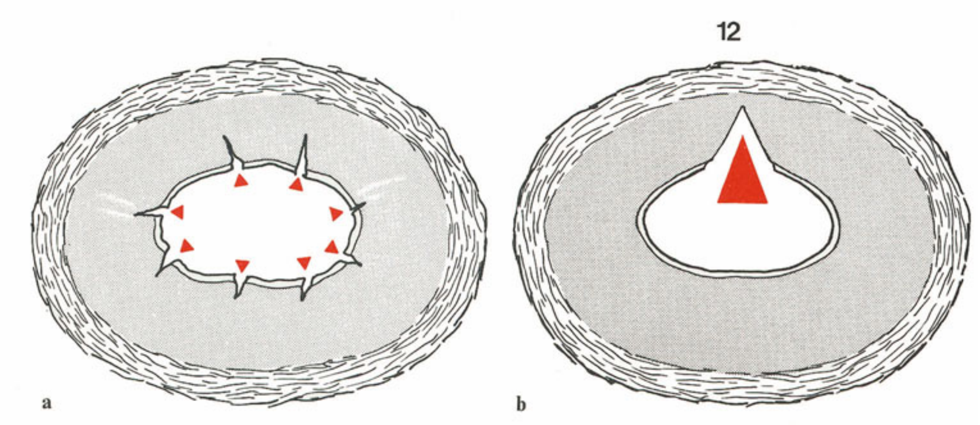


Fig. 64a, b. Comparison of blunt dilatation and internal urethrotomy. a Blunt dilatation of the urethra nearly always gives rise to multiple tears. One may easily convince oneself of this by urethroscopy following the passage of metal or plastic sounds. **b** Internal urethrotomy gives rise to a sharp smooth incision

used only to incise the most anterior part of the urethra, since the exact caliber of the more proximal segments is not at this time known with certainty. Urethrography will only have revealed the more obvious variations in caliber. Unless a further more proximal narrowing occurs, the resectoscope will now sink slowly into the bulbar urethra.

Since the transition from the navicular fossa to the penile urethra, already described, will also have been incised by this process, no further difficulty will be encountered in this region. The situation is different if the external meatus is wide but a narrow transition occurs beyond the fossa. In this case the procedure described for the external meatus should once again be followed. The rule should thus be to allow the instrument itself to seek out urethral stenoses. These areas may then either be visualized by urethroscopy or immediately incised with the Otis urethrotome.

γ) The Modified Otis Urethrotome. The Otis urethrotome is an historical instrument which has persisted in contemporary practice since first being described at the turn of the century.

For a variety of reasons we have modified this classic and brilliantly conceived instrument:

1. Incisions were made with the original instrument by withdrawing it down the urethra with the knife extended and *set* to the required Charrière caliber. The conically tapering instrument thus not only incises but also dilates the urethra. Consequently the depth of cut does not always correspond to the caliber set.
2. A very narrow urethra may prevent the instrument from being opened to the required caliber. The incision must therefore be made in two or three stages, each of which requires reintroduction of the instrument, since it will only cut when it is withdrawn distally with the knife in working position.

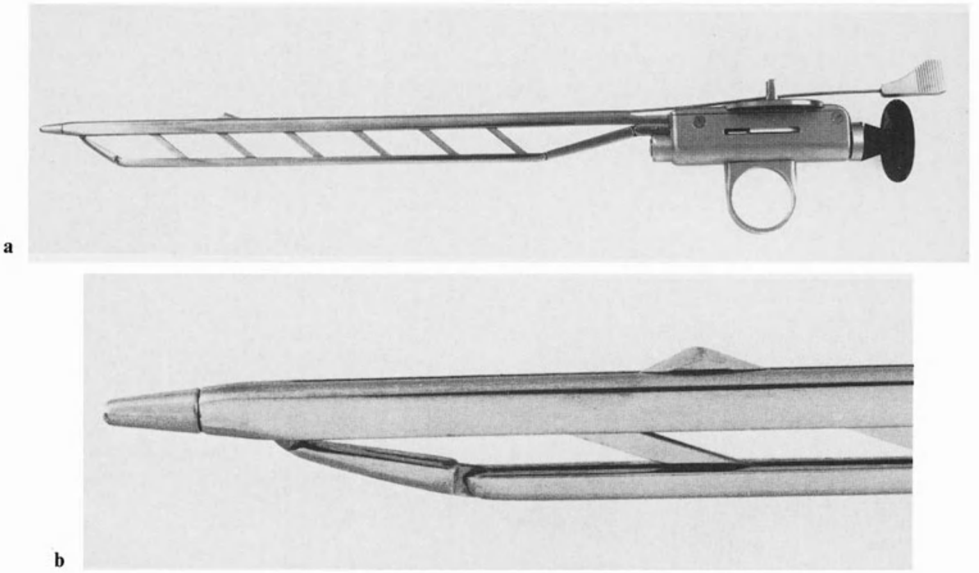


Fig. 65a, b. Otis urethrotome. a In this revised model the instrument opens as a virtual parallelogram, thus dilating all parts of the urethra to the same extent. This also allows an alteration of cutting technique (see text). **b** The blade is ground to a roof top profile, thus permitting incisions to be made in both directions

3. The consequence of this procedure is that the second and third incisions are not always made in exactly the same place (the 12 o'clock position) as the first. Their exact point on the circumference of the urethra is more or less a matter of chance.
4. If the knife is retracted somewhat too far, it will no longer lie opposite the greatest diameter of the open instrument. Exact definition of the depth of cut is thus lost.

Our modification consists of two alterations (Fig. 65):

1. The instrument no longer opens in a conical fashion but as a parallelogram along its length.
2. The knife is ground in such a fashion as to cut both on advancement and retraction. The blade is thus modeled on that of the Maisoneuve instrument.

These slight changes in construction permit a series of new maneuvers:

1. The instrument is passed through the stricture and opened until it lies in close contact with the lumen. The first cut is then made by moving the knife from its resting position and then further withdrawing it. The instrument itself is not moved.
2. If it becomes necessary to deepen the cut the Otis urethrotome is then opened a few Charrière units until it once again lies in firm contact with the urethral wall. A further cut is then made by readvancing the knife in a proximal direction.
3. This process may be repeated continuously until the required urethral lumen has been achieved.

It should, however, be noted that the instrument only incises the urethra if the latter is in close contact with the instrument. At points where the urethra is wide and unstrictured there will be no or only a shallow incision.

b) Sachse Urethrotomy Under Direct Vision During Instrumentation

In recent years we have made it our practice to incise urethral strictures obstructing passage of the resectoscope under direct vision with the SACHSE urethrotome. Instead of the cutting loop, a SACHSE knife is mounted on the electrotome and the stricture incised under direct vision until the resectoscope sheath passes easily. See Chap. L for the technique of this procedure.

c) Instrumentation Under Direct Vision

Direct visual control of passage is a justifiable technique in various fields of endoscopy, having richly increased our knowledge of the urethra – for so long the poor relation in urology. The advantages of this technique are not quite so manifest when passing a resectoscope.

1. If an obturator of the LEUSCH pattern is employed, the rubber cuff so copiously shrouds the sharp edge of the aperture as to bring about a slight urethral dilatation.
2. Despite a good irrigation flow, the sharp edge of the aperture may nevertheless traumatize the urethra at its narrower points if direct viewing is employed.
3. The method of introducing the sheath under its own weight makes it impossible to employ force and at the same time is a diagnostic maneuver for detecting stenoses. During direct viewing instrumentation one is tempted to overcome the stenoses by rocking movements of the sheath which is thus advanced, rather than being allowed to come to rest at the obstacle, where a urethrotome would then be substituted for the resectoscope.
4. In addition to this, the technique of advancement under gravity is successful in more than 80% of our cases. Gentle pressure with the tip of a single finger is usually adequate to advance the instrument from the bulbar into the prostatic urethra since the instrument normally seeks out the passage almost of its own accord unless it is forcefully deviated.

Despite these counterarguments there are various points in favor of instrumentation under direct vision:

Whenever resistance is felt, visualization of the obstacle and slight corrections of position may allow a contracture or fold in the urethra to be circumvented.

True strictures may be diagnosed under direct vision and incised with the Sachse knife. Special viewing inserts which direct the irrigation flow against the mucosa and lift it off the instrument so as to prevent injury, allow particularly gentle instrumentation.

d) Optical Aids to Passage of the Sheath

The sheath may be passed either with a SCHMIEDT viewing obturator, the electrotome itself or with the SACHSE urethrotome in situ. The individual choice among these methods will depend on circumstances.

1. If nothing further than a direct view of the process of instrumentation is required, the Schmiedt viewing obturator is the correct instrument. Its chief advantage over the electrotome as a viewing insert lies in the fact that it is a true obturator virtually occluding the sheath aperture.
2. The electrotome is suitable for cases which could be instrumented blind, but in which there are other reasons for wishing to view the urethra.
3. The Sachse knife should be used whenever previous urethrogram or cystoscopy has revealed a stricture which will require incision during instrumentation.

4. Trauma During Instrumentation

a) Preliminary Considerations

In our experience, injury rarely occurs if urology residents are properly trained, and if the rules previously described are strictly adhered to. Passing the resectoscope is generally the first step in the training of a budding transurethral surgeon. Long before our young colleagues carry out their first cut they are given ample opportunity to pass the instrument under supervision, having first on several occasions seen the practical application of these rules through a teaching attachment. Observation of the rules thus becomes second nature.

If the trainee should arrive at a truly impassable obstacle, instrumentation will be continued under direct vision. Only at this point will a more experienced colleague intervene and clarify the situation.

Apart from the stretching injuries already described, the following types of trauma may occur:

1. False passage below the external sphincter
2. False passage above the external sphincter

In 35 years of practice I have never seen a perforation of the urogenital membrane. This tissue is far too tough and resistant.

b) Injuries Below the External Sphincter

Below the external sphincter the instrument may find a false passage out of the bulbar urethra (perhaps already deformed by poor catheterization) into the perineum. The nature of the fascial layers and the self-evident inappropriate direction quickly reveal the error, since the urogenital membrane almost completely resists passage of the instrument.

c) Injuries Above the External Sphincter

Above the external sphincter a false passage may lead ventrally or dorsally.

α) Ventral Injuries. After leaving the midline, a ventral false passage might enter the substance of one or other lateral lobe. This is by no means a disaster, as long as the perforation is intracapsular and the instrument eventually reaches the bladder by this detour through the lateral lobe. Such an accident may occur in the presence of an extremely asymmetrical configuration of the lateral lobes with consequent deviation of the midline toward the less developed side. If an experienced operator takes over at this point, the complication is harmless, since the instrument may be used to cut a passage from lateral to medial through the lateral lobe back into the urethra. Alternatively the instrument may be retracted beyond the point of the perforation and the correct way into the bladder through the distorted urethra sought under direct vision.

Once again this is an extremely rare complication, which I have only experienced twice. In both cases the operation was successfully concluded without further problems. BAUMRUCKER (1968) describes this complication as "accident 13".

β) Dorsal Injuries. Dorsal perforation can only occur if particularly extensive ventral protrusion of a median lobe impedes instrumentation.

This "detour" into the bladder is, however, of no significance for the patient as long as it remains intracapsular and is recognized for what it is at an early stage. As for other intracapsular lobar perforations, this problem may be corrected either by retraction of the instrument and advancement under direct vision or by ablation of the hyperplastic tissue around the perforation. In the latter case a way is cut through adenoma tissue into the urethral lumen proper, the landmarks lying in correct appreciation of the tissue structure.

γ) Subtrigonal Perforation. Perforations under the trigone are considerably more problematic, resulting from further advancement after perforation of the median lobe in a frenzied attempt finally to enter the bladder. The capsule is perforated and the instrument comes to lie beneath the trigone. In such a case the view up the electrotome will reveal not bladder mucosa but the web-like strands of fatty areolar and loose perivesical tissue.

If this occurs, it is preferable to abandon immediate surgery and operate after 3–4 days' indwelling catheterization.

This type of perforation is discussed in further detail in Chap. D.VI.1.e) and in Fig. 125.

5. Orientation at the Site of Resection

Orientation may be difficult in a cavity of complex configuration, occurring as it must by means of a monocular optical instrument.

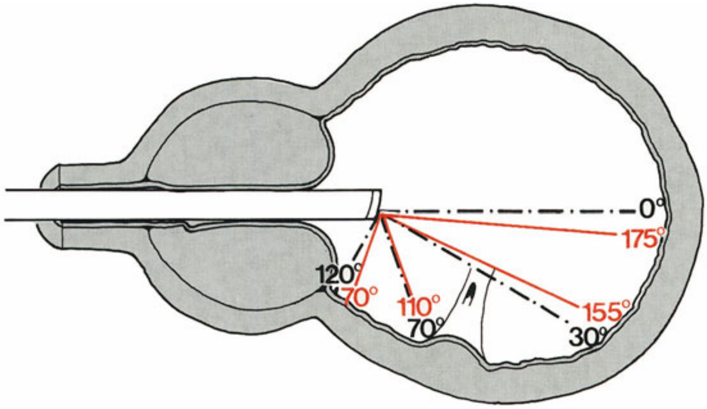


Fig. 66. Viewing direction of various telescopes. Dotted lines: Optical axis of Storz telescopes as used by us. In this context 0° means that there is no deviation of the optical axis from strict forward viewing. Other manufacturers use a descriptive system in which such a telescope would be designated 180°. Slight deviation of the axis can thus be described as 175°, indicating that the direction of view deviates by 5° from straight ahead. This principle applies equally to other numerical denominations

a) Telescopes for Inspection of the Bladder and Bladder Neck

Three different lens systems are available for this purpose, differing in their viewing angle (Fig. 66). The different direction taken by their optical axis will result in a different appearance of individual structures. We shall discuss this in terms of an every day example which clarifies the principles involved.

Metaphorically speaking, the bladder neck with its two lateral lobes impinging on the cleft-like urethra resembles a ravine. End-viewing telescopes will provide the image one might have of the ravine through a panoramic telescope set up in a central position and looking up the ravine. To the extent that the axis is angulated, the image will resemble that obtained from a bridge crossing the ravine. 90° telescopes look vertically down from the bridge to the floor of the ravine. Retrograde systems will provide an image of the ravine such as might be obtained by leaning over the bridge and looking back under it towards the mouth of the ravine.

This metaphor is a useful model for thinking about the bladder neck, since the observer is forever prone to the illusion that what he happens to see with any given telescope is a true image of the actual anatomy. It must be emphasized that there are as many perspectives of the bladder neck as there are telescopes. In practical terms, this means that the urologist examining this intricately configured cavity must get to know its appearance at a variety of viewing angles, so as to develop a three-dimensional concept closely approximating to reality.

Two further points are worthy of consideration:

Firstly, only a single telescope is used for resection – a forward-viewing type with up to 15° angulation. Orientation during surgery must occur with this system. As a result, the beginner must become accustomed to the viewing angle of this telescope, so as to be capable of recognizing things which he cannot see directly but may estimate by their movement, their behavior and

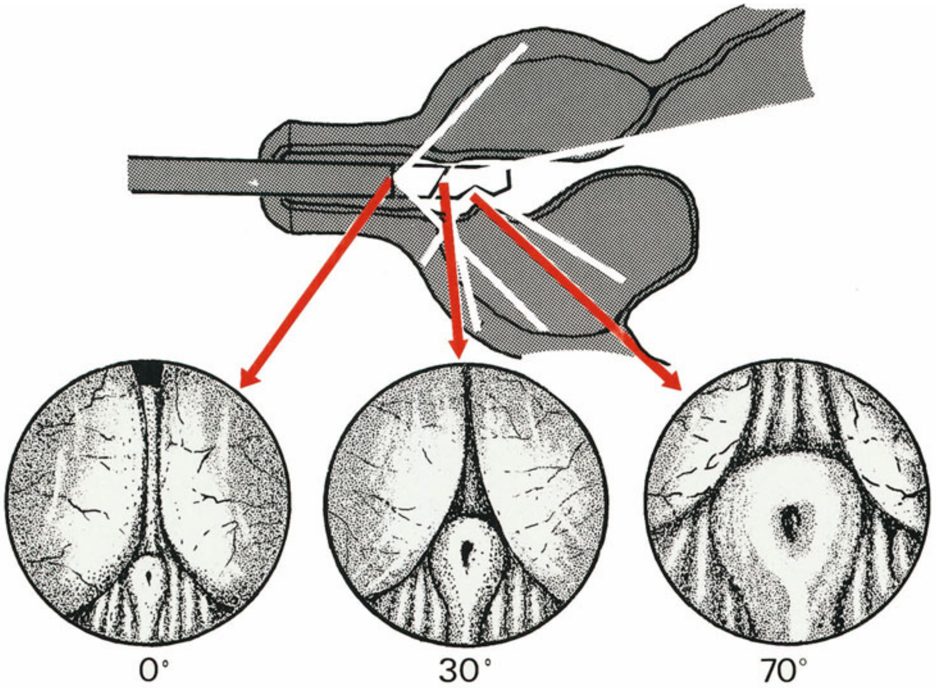


Fig. 67. Simplified appearance of the verumontanum as seen by three different telescopes. *0° telescope:* the verumontanum and both lateral lobes are seen here through a forward-viewing telescope looking straight up the urethral cleft (viz. the ravine analogy in the text). The optical axis is approximately in the center of the field, and urethral structures are thus represented in equal perspective around the periphery if the instrument is held horizontally. *30° telescope:* A slightly downward view onto the verumontanum. Only the lower parts of the lateral lobes are visualized. *70° telescope:* Almost vertical view of the urethral floor. Only the verumontanum and roots of the lateral lobe are visible. If held horizontally, such a telescope gives a distorted view of the extent of the lateral lobes

the shadows cast. Thus, for example, endovesical protrusion of a median or lateral lobe cannot be definitely recognized as such from below with a forward-viewing telescope, but the mobility and the relationship of adenoma tissue to exposed fibers of the internal sphincter muscle will announce the presence of endovesical adenoma to the experienced operator.

Secondly, the slightest hemorrhage during operation will make it totally impossible to obtain any view with any telescope except the forward-viewing system of the electrotome. All other telescopes will show nothing but red on red and only very close approximation to the mucosa or the wound will allow poor view of a small area. Except for what was seen before the operation with other types of telescopes and carefully committed to memory, no further orientation will be possible.

It is these two points which render preoperative inspection with all three telescopes, the forward-viewing, the side-viewing and the retrograde, so important for the beginner who has to learn to assemble in his mind the three perspectives into a spatial image (Fig. 67). During the operation proper he will have to depend solely on his end viewing telescope.

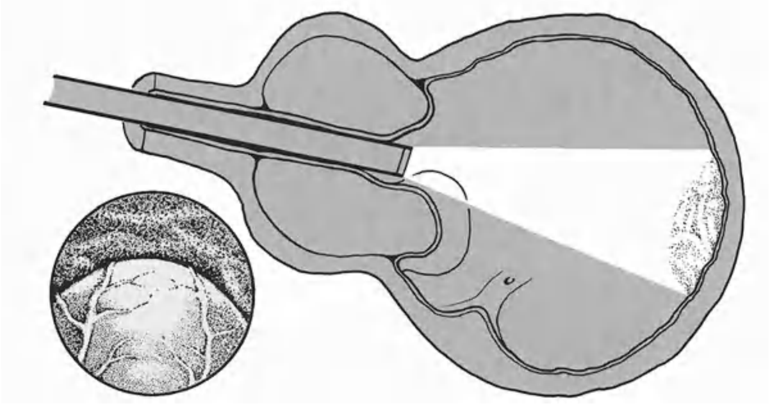


Fig. 68. Diagrammatic representation of the field of view of a 0° telescope. The field includes a median lobe protruding somewhat into the lumen, its summit just visible. Beyond, the posterior wall of the fully distended bladder is visible

α) The End Viewing Telescope. As already discussed in the example of the ravine, this telescope looks in a forward direction only (Fig. 68). Only by moving the instrument in the appropriate direction, left and right laterally as well as ventrally and dorsally, may the lateral, ventral and dorsal areas of the prostatic urethra be assessed. In addition, advancing and withdrawing the instrument allows one to wander up and down the ravine. One may draw on this metaphor yet again to point out that a narrow field of view may to some extent be compensated for by viewing the object from a greater distance (Fig. 69). In practical terms this means slightly withdrawing the instrument so as to gain a greater distance from the object. Thus the entire circumference of the paracollicular area can only be seen within a single field if the instrument is somewhat retracted into the membranous urethra. This is particularly true if tall and voluminous lateral lobes give the urethra an increased dorsiventral extension.

The female bladder could be completely surveyed with this telescope, since the urethra is so short and so mobile as to allow the instrument to be angled in all directions. In the male, however, the urethra is considerably less mobile due to the firm fixation of its membranous and prostatic parts, and in addition to this, endovesical portions of the adenoma obscure the view of recesses lateral or caudal to these nodules.

If, however, the obstructing portions of the prostate are ablated, the entire male bladder may also be viewed under operative conditions with an end viewing. Such a maneuver may be necessary, e.g., for the resection of bladder tumors in the vault and on the lateral walls near the internal meatus. If, in addition, external counterpressure is applied suprapubically the ventral bladder wall will be visualised. Then there is in the male bladder equally no area which cannot be seen with an end viewing telescope and approached surgically.

A poor view of the lateral and ventral areas of the bladder base indicates endovesical growth of adenoma.

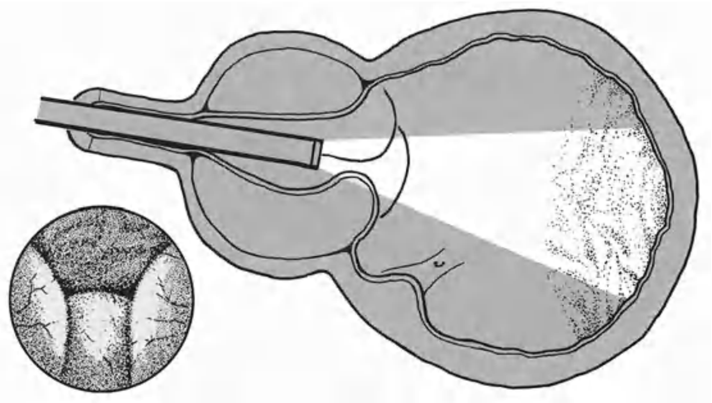


Fig. 69. Diagrammatic representation of the field of view of a 0° telescope. The same situation as in Fig. 68, but with the instrument somewhat withdrawn. In this bladder neck both lateral lobes are seen in the endoscopic image. The field of view, and therefore the extent of the area visualized, depends to some extent on the distance between the front lens of the telescope and the objects being viewed

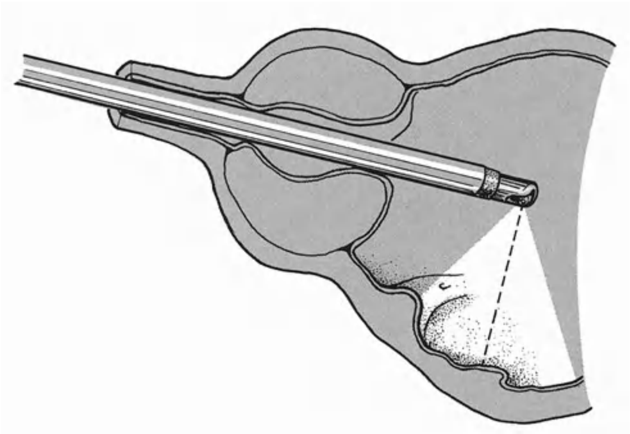


Fig. 70. Diagrammatic representation of the field of view of a diagnostic telescope. The telescope looks straight down onto the bladder base. At the distal margin of the field the left ureteric orifice is visible, while the proximal margin is in the base of the bladder. Further retraction of the instrument would allow the "retrograde" region of the field to view the transition between bladder base and the only mildly enlarged endovesical portion of the adenoma

The technique of rocking (see Fig. 72) the instrument in various planes [Group III, Sect. IV.5.b)γ)] allows a good overall view of the prostatic urethra. The configuration of the internal meatus may be appreciated at the same time.

β) Diagnostic Telescopes. This term applies to all telescopes with an axis angle of 30–90° (Fig. 70). They allow a good overall view of all parts of the bladder and the internal meatus which are hard to see with an end viewing. In addition they are quite indispensable for a careful examination of the bladder mucosa.

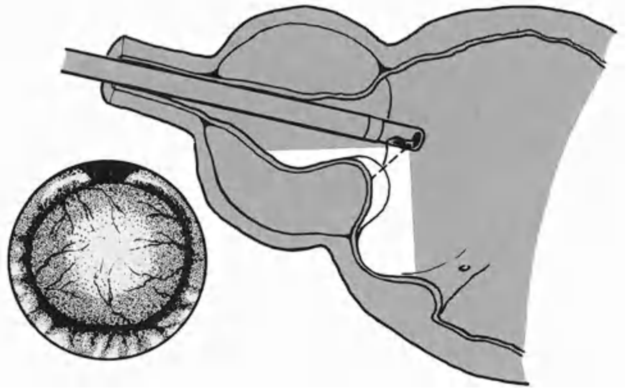


Fig. 71. Examination of the bladder and its base with a retrograde-viewing telescope. The telescope only projects a short way into the bladder but nevertheless views the entire median lobe and even part of the prostatic urethra. With this type of telescope, assessment of the anatomic situation is more difficult than with other types, which may explain the moderate popularity of retrograde systems. They are, however, indispensable for the assessment of cases in which protuberant endovesical adenomas may mask tumor in the angle between adenoma and bladder wall (see Fig. 199)

Those with a wide field of view may even be used in place of retrograde-viewing telescopes, since an instrument with a 90° optical axis and a 90° field of view will be half forward- and half retrograde-viewing. Such wide-angled telescopes give a valuable view of the overall relationship in large expanses of bladder. This is particularly true of structures at the internal meatus, where nodules of median and lateral lobes are often tightly pressed together with deep clefts between, and such diagnostic telescopes with their "bird's eye" perspective may allow a considerably better assessment of the overall situation.

A wide-viewing angle is also of importance when inspecting the retroprostatic recess. In this region there may be a deep depression between internal meatus and bladder base or trigone. Particularly in cases with a tall median lobe the bladder base may be quite hard to visualize, occasionally requiring a retrograde-viewing telescope.

These telescopes are of little value for diagnostic inspection of the prostatic urethra.

γ) Retrograde-Viewing Telescopes. The principle of this telescope dates to the days of NITZE, who published the design of a retrograde cystoscope. This viewing angle is of particular importance in assessing regions of the bladder around the internal meatus (Fig. 71). In conjunction with the two previous lens systems, this telescope gives an excellent view of endovesical portions of the adenoma. The perspective is not, however, easily understood unless one routinely uses it in everyday practice. It is once again true that nothing may be seen with this telescope during surgery, once the irrigating fluid is blood-stained.

We have only recently started to use retrograde telescopes, which is to say that we had previously carried out all preoperative assessment of the bladder neck *without* such systems and without any impairment of our results. The training of our younger colleagues is, however, greatly improved if they are able to obtain a view of the operating field around the bladder neck from within the bladder, so that they can more easily learn the art of endoscopic visualization.

b) Directional Features of the Bladder Neck

Spatial orientation at the bladder neck is greatly facilitated by understanding the optical characteristics of various telescopes. A further aid is afforded by considering the area in terms of directional pairs corresponding to the three dimensions. It will thus be possible for surgeon and observer alike to find any location within the prostatic capsule on purely descriptive information.

α) Group I Features: Distal-Proximal. This axis corresponds to the longitudinal axis of the urethra, and the instrument is slid forward or backward along it.

At the proximal edge of the urethra, the internal meatus, various forms of transition to the bladder may be observed. In the presence of a short transverse bar, the floor of the prostatic urethra falls away after a brief rise during which tissue closely approaches the front lens.

A protuberant median lobe looks quite different. In this case the instrument, or at any rate its ventral portion, is already within the bladder which may be seen straight ahead by the observer, while tissue of the median lobe continues to be seen beneath the telescope (see Fig. 74). 0° degree instruments give the most realistic representation of this state of affairs, since the far wall of the bladder may then be seen even when part of the median lobe is still in the field of view at 6 o'clock.

Further withdrawal of the instrument will reveal a sinking away of the floor of the prostatic urethra. The median lobes drift past on either side and the verumontanum surfaces at 6 o'clock. In a normally developed verumontanum, the small fold of the utriculus is easily seen, and more distally the urethral crest.

The relationship of the lateral lobes to the verumontanum should be noted, the former being recognized by their convexity. Unfortunately (with resulting difficulty in orientation) this convexity may lead them to bulge somewhat distal to the verumontanum, a fact which may be appreciated from the distribution of light and shade.

Most distally of all lies the external sphincter [see Sect. IV.6.f)]. The greater range of morphologic variation in this region is apparent from Plates I–III, Illustrations 1–16. The detailed captions to these illustrations serve to supplement what has been said here.

β) Group II Features: Clockwise Rotation. The resection area may be divided into segments corresponding to the points of a clock dial so as to facilitate orientation when rotating the instrument. The most obvious mark on this dial is the verumontanum, seen on the floor of the urethra at 6 o'clock. Its ventral

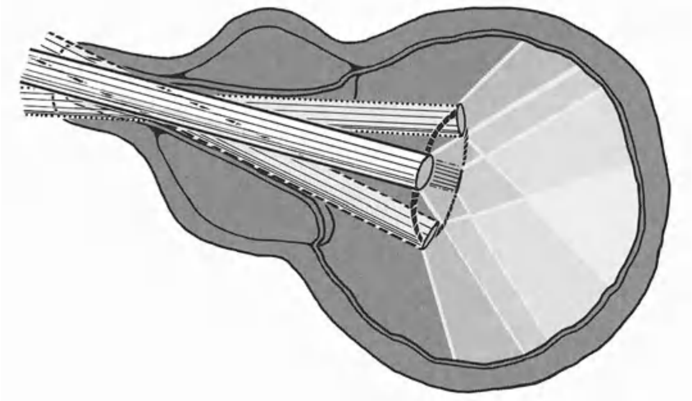


Fig. 72. Diagram to show the method of extending the field of a forward-viewing telescope in all directions. The telescope pivots in the urogenital diaphragm. This is its fulcrum, or rather the apex of a cone described by the telescope axis. By this means, large expanses of bladder may be visualized by a forward-viewing system. Under general anesthesia, retraction of the instrument and abdominal pressure on the bladder vault will allow any part of the bladder mucosa to be seen

opposite number is the commissure of the lateral lobes, whose point of communication may nearly always be seen with the necessary clarity. This will not be the case in the presence of a rare anterior lobe forcing the lateral lobes apart after the fashion of a median lobe. By rotating the instrument clockwise one may appreciate the configuration of the internal meatus. For example, there is nearly always a deep groove marking the dividing line between median and lateral lobes. This maneuver also allows a volume appreciation of the lateral lobe if the instrument is withdrawn on into the prostatic urethra; the bulging lobes will then be seen returning to their original position whence they had been laterally displayed by the instrument.

Together with the features of Group I (distal-proximal), this division into segments permits extremely accurate description of a point within the resection field. Such topographic cues are of great importance if a vessel that had not been sealed during a first filling of the bladder requires further coagulation, or if one wishes to describe to an observer an area of interest which he is to seek out. In this context, see Color Illustrations 1–16 (Plates I–III). Illustrations 1–7 relate to the topography of the verumontanum, the ventral commissure is seen in Illustration 11.

γ) Group III Features: Lateral-Medial, Dorsal-Ventral. Movement of the instrument in these planes will describe a cone within the bladder neck (Fig. 72). In the male the instrument is after all fixed at a fulcrum in the membranous urethra. Moving the external end of the instrument up and to the right will correspondingly shift the beak to the left and depress it. This property is employed when the capsule is being freed of adenomatous tissue (teaspooning) by digging movements of the cutting loop induced by moving the external end of the instrument. In the first phase of resection, during which a funnel-shaped section of the adenoma is ablated, the margins of the funnel correspond, on a reduced scale, to excursions of the eyepiece.

6. Examination of the Bladder Neck

a) Preliminary Considerations

On the basis of this final preoperative examination, it will be decided whether transurethral surgery or some enucleation procedure is more appropriate. It is, however, true to say that an experienced operator will have little doubt by the time this point is reached.

The second object of a detailed bladder neck examination is to devise an exact plan of operation, and the younger urologist will take this opportunity to gain the most exact knowledge of anatomic relationships in this region. We are of the opinion that a beginner must have carefully examined at least 50 bladder necks before he is ready to undertake an actual resection. During these inspections he should have the benefit of some commentary from a more experienced surgeon who will demonstrate the various regions of the bladder neck and discuss them individually.

b) Assessing Bladder Neck Length

The first feature of the bladder neck to be assessed is its length. This may be done by visualizing two fixed points, the internal meatus and the verumontanum with the end viewing telescope and noting the position of the glans along the sheath of the instrument for each one (Fig. 73).

The first practical step is to advance the instrument into the bladder until the rear wall of the latter may be seen. The instrument is then slowly withdrawn. The first measurement is made when the internal meatus rises into view, by placing a finger on the sheath where it emerges from the urethra. The resectoscope is now slowly withdrawn until the verumontanum is fully seen. The measuring finger remains applied to the original mark. The distance along the sheath between the external urethral meatus and the finger corresponds to the length of the bladder neck.

Errors may be introduced into this measurement by the presence of a high-lying adenoma or an extensively endovesical median lobe necessitating a concertina movement of the penis to visualize the internal meatus. Equally, the penis may stretch during retraction of the instrument if the external meatus is rather a tight fit around the sheath. Furthermore, correct registration of the internal meatus may be rendered difficult if a protuberant median lobe obliterates any clear borderline. Under these circumstances, it is important that length assessment be made on the basis of the median lobe and not in terms of the lateral lobes which generally protrude less far into the bladder. Errors of several centimeters would then be liable to occur.

This bladder neck measurement corresponds quite accurately to prostatic size and thus to the expected volume of tissue.

Our experience to date suggests that prostatic volume as assessed by a rectal ultrasound probe correlates well with this length measurement. Optical measurement of this type has a further special value for the operator, since its outcome

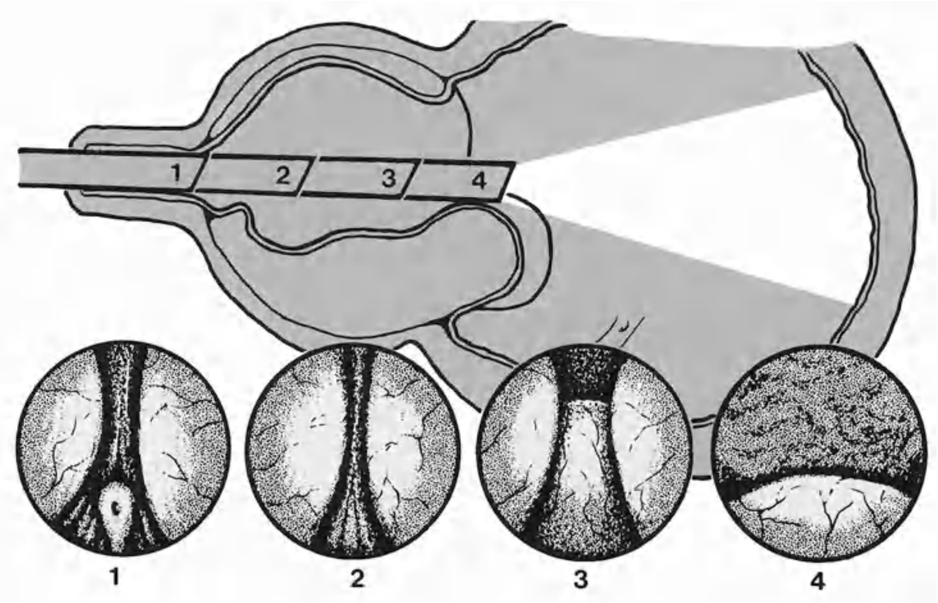


Fig. 73. Measuring the bladder neck. The instrument is advanced into the bladder until no part of the bladder neck structures is visible. Measurement is then commenced by gradually withdrawing the instrument until the internal meatus appears in the field of view. Measurements are taken from this point by applying a finger to the resectoscope sheath. The instrument is then further withdrawn until the verumontanum is visisble, when the distance between the glans and the finger on the sheath will correspond to the length of the bladder neck. Care should be taken that a narrow external meatus does not lead to stretching of the glans, thus giving a false measurement. *1* The verumontanum appears in the field. *2* Further advancement into the bladder. The lateral lobes are in contact centrally. *3* The median lobe appears in the field of view and the lateral lobes recede. *4* The summit of the median lobe still just visible

will materially influence his operative strategy. For equal overall length, a bladder neck with a large voluminous median lobe will require a different technique to hyperplasia restricted mainly to two large lateral lobes.

c) Depth Assessment of the Urethral Cleft

This value can only be estimated, not measured (Fig. 74). It is mainly determined by the behavior of the lateral lobes, which in the well-known way convert the urethra into a flattened scabbard-like cleft, whose greatest extension is in the dorsiventral direction. A first impression of lateral lobe volume may be gained by viewing the bladder neck from the region of the verumontanum. The instrument is then further withdrawn into the membranous urethra, thus giving a good overall view. Raising and lowering the eyepiece will reveal the ventral and dorsal extent of large nodules. In very large hyperplastic glands, it is only the integration of a number of views obtained in this way that will allow an overall assessment. The instrument is then advanced toward the bladder and the behavior of the lateral lobes studied at various levels. The area of

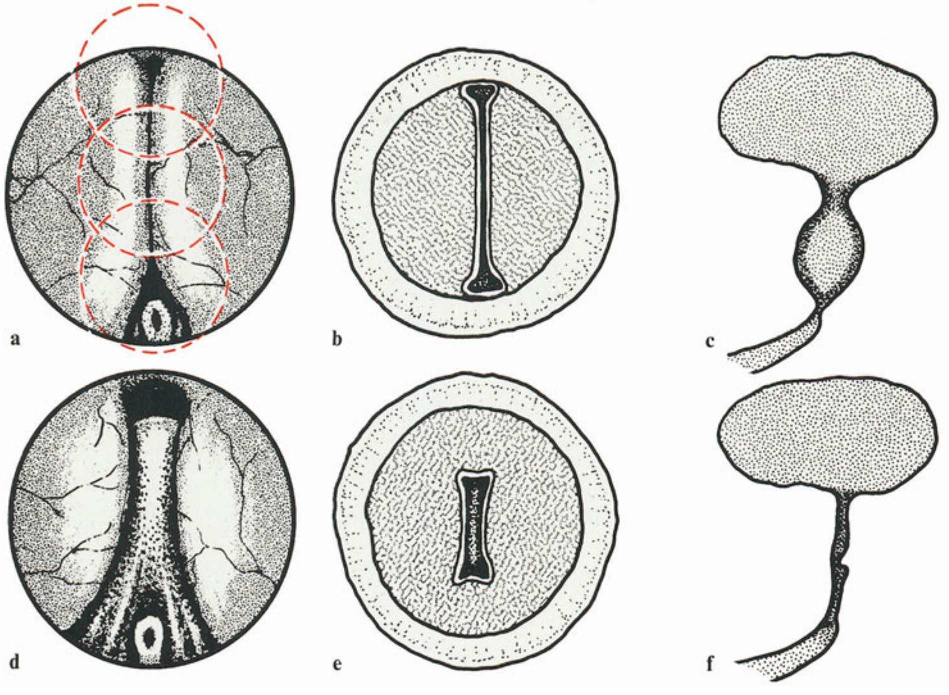


Fig. 74a–f. Assessing the caliber of the urethral cleft. a–c Dorsiventrally capacious urethral cleft. **a** Endoscopic appearance: this sketch is a composite of 3 individual fields of view. With the telescope in a neutral horizontal position only the equatorial portion of the lateral lobes is seen. A lower view reveals only the verumontanum and the dorsal limits of the lateral lobe. An upward view visualizes the anterior commissure of the lateral lobe. **b** Schematic cross section through the prostate. *c* Schematic drawing of the corresponding cystourethrogram. *d–f* Dorsiventrally restricted urethral cleft. **d** A single position of the telescope allows one to take in the verumontanum and both lateral lobes. **e** Schematic cross section of the prostate. **f** Schematic drawing of the corresponding cystourethrogram

contact between the spheroidal lobes may be seen, as may their dorsal and ventral parting. The same raising and lowering of the eyepiece is required at each of these observation points.

It is thus the two lateral lobes which keep the cleft of the prostatic urethra open. This situation persists for some time during resection, even though large portions of adenoma may already have been removed. If the remaining lateral lobe tissue is again inspected from the level of the verumontanum, it may be seen that the residual *apical* tissue, i.e., the most distal part of the lateral lobe vestiges, continues to hold open the urethral cleft. Only when this remaining tissue is finally removed does the urethra return to its original shape (see Fig. 144; Plate IX, Illustration 54).

In smaller glands, on the other hand, both the dorsal and ventral walls of the prostatic urethra may be seen within a single field; only in close proximity to the front lens are they lost to view. By the same token the increase in breadth of the gland may be so slight as to be hardly apparent to the operator, since the instrument sheath will tend to hold the lateral lobes apart.

Color Illustrations 10 and 11 (Plate II) clearly show how the prostatic urethral cleft is held open by the lateral lobes. Illustration 16 (Plate III), on the

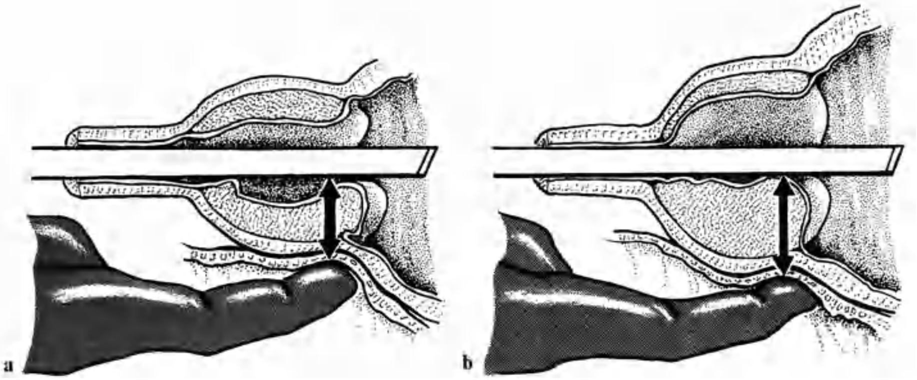


Fig. 75a, b. Assessing the dorsal tissue volume by rectal palpation against the resectoscope sheath. **a** The thickness of tissue on the floor of the prostatic capsule may only be determined with adequate accuracy if it is palpated with the resectoscope sheath acting as a thrust point. In this sketch there is a small quantity of tissue. **b** More copious dorsal tissue. This preliminary examination is indispensable for resecting down to the floor of the capsule

other hand, shows that this aperture need by no means be symmetrical, and in this illustration the left lateral lobe bulges far over to the right, thus displacing the urethral cleft. Illustrations 1, 2, 4 and 5 (Plate I) are examples of a narrow urethral cleft.

d) Dorsal Tissue Volume

The layer of adenomatous tissue lying between the floor of the prostatic urethra and the capsule may be of varying thickness. Particularly at its proximal end, where median lobe tissue protrudes into the prostatic cavity, this layer may be considerably developed. A combined examination technique will reveal this, since the tissue will separate the resectoscope sheath from a rectally palpating finger (Figs. 75 and 76). The more laterally placed tissue is less reliably assessed by this method if the urethral lumen falls away steeply between the lateral lobes. Since the resectoscope sheath lies in the midline between two lobes there is no counter-resistance to rectal palpation of the latter. For long bladder necks, a midline profile of the prostatic urethra may be palpated.

e) The Verumontanum

In most cases the verumontanum is a conspicuous and easily recognized anatomic structure. Various changes may make it more difficult to visualize: massive lateral lobes may cover it, edema or tumor in the vicinity may obliterate it.

α) Free-Standing Verumontanum. This is easily seen even from the membranous urethra as the instrument is advanced toward the bladder under direct vision.

Such a situation arises whenever the lateral lobes are only modestly developed, e.g., in cases of transverse bar, small adenoma or predominant median

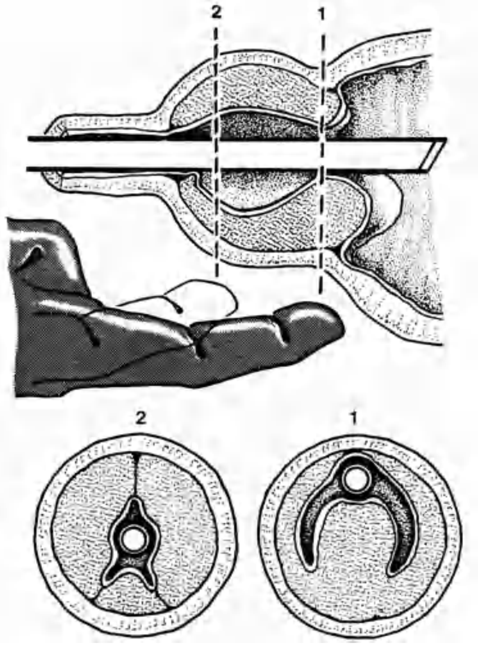


Fig. 76. Assessing the dorsal profile of the prostatic urethra. In addition to the technique shown in Fig. 75, the profile of tissue along the floor of the prostatic capsule may thus be assessed. 1 Palpation close to the internal meatus where there is a substantial median lobe. 2 Palpation close to the verumontanum: sparse tissue

lobe hyperplasia. Due to the optical distortion introduced by all types of telescope, the verumontanum appears very large when viewed at close quarters. It stands well clear of the easily visualized bladder neck (see Plate I, Illustrations 2 and 3). The more the lateral lobes are developed toward the midline, the more its lateral portions appear flattened. Alternatively, the verumontanum may still be visisble and yet its sides are compressed and covered by adenoma nodules on the floor of the prostatic cavity. In such cases only its anterior surface, directed toward the instrument, will remain visible. Such an arrangement is really a transition to the configuration in which the verumontanum is so taken up by lateral lobe tissue as to no longer be immediately visible.

β) Covered Verumontanum. In these cases two related processes lead both to a sinking of the prostatic urethral floor and to a crowding together of the lateral lobes in the midline. Since the lateral lobes enlarge not only laterally and medially but also in a dorsiventral direction, the dorsal part of the prostatic cavity is pressed further back, carrying with it the urethral floor and verumontanum. Nodules proliferating toward the midline go on to cover the latter completely.

For observation purposes this process may be reversed, either by a finger in the rectum elevating the floor of the prostatic cavity, or by "dipping" the beak of the instrument into the depth of the prostatic urethra, so as once again to render the verumontanum visible (Fig. 77). During operation both maneuvers will blend imperceptibly with one another, and their technique should be practiced at the time of examination (Plate I, Illustration 6).

γ) Poorly Visible Verumontanum. Even if the lateral lobes are less pronounced, the verumontanum may be poorly seen for one of four reasons.

1. Prostatic carcinoma. Carcinomas of the prostate which have spread considerably toward the external sphincter may infiltrate the entire urethral zone, thus obscuring or indeed completely effacing the verumontanum. Even if the site at which it should lie is freely visible, infiltration or edema of the mucosa, or occasionally a local protrusion of tumor, may so markedly alter the local topography that even an experience surgeon is unable to identify the verumontanum. This will cause considerable difficulties in operative orientation, and stimulation of the external sphincter with the apparatus of TAMMEN may, in these cases, help to avoid sphincteric trauma. A safe rule in cases of doubt is to err on the side of leaving some tissue at this point, since this would be amenable to subsequent resection if adequate micturition is not established postoperatively. A second operation is infinitely preferable to incontinence.

2. Papillary tumors of the prostatic urethra. This represents a somewhat different situation, since the verumontanum may usually be visualized if the urethra is dissected free of tumor, starting at the proximal end. It is then frequently possible to dissect the verumontanum out of the papillomatous mass so that it is clearly demonstrated at the end of the procedure.

3. Edema of severe inflammation. Similar difficulties occur when the verumontanum is poorly seen as a result of inflammatory change. This occurs in long-term catheter patients, in severe inflammatory conditions of the prostatic glands and in the wake of abscesses around the urethra. Some inflammatory processes may give rise to pseudopapillary change of the mucosa which may render the structures of this region unrecognizable.

4. Trauma of previous surgery. Particular problems arise if the verumontanum was partially or completely ablated during previous procedures, or if cicatricial bands distort or cover it. This may be the result of previous transurethral or enucleative surgery. Edema at the wound margins of previous surgery may present further problems, and in this situation testing of the sphincter (TAMMEN and HARTUNG 1973, 1976; HARTUNG 1979) has become an indispensable aid.

δ) Aids to Seeking the Verumontanum. In this type of case rectal palpation may be useful, since it enables one to feel the prostatic capsule, and one then has a more accurate idea of where to look. Such counterpressure may occasionally also unfold paracollicular infiltrations. The verumontanum is easily distinguished from protrusions of similar appearance by the mucosal fold of the utriculus.

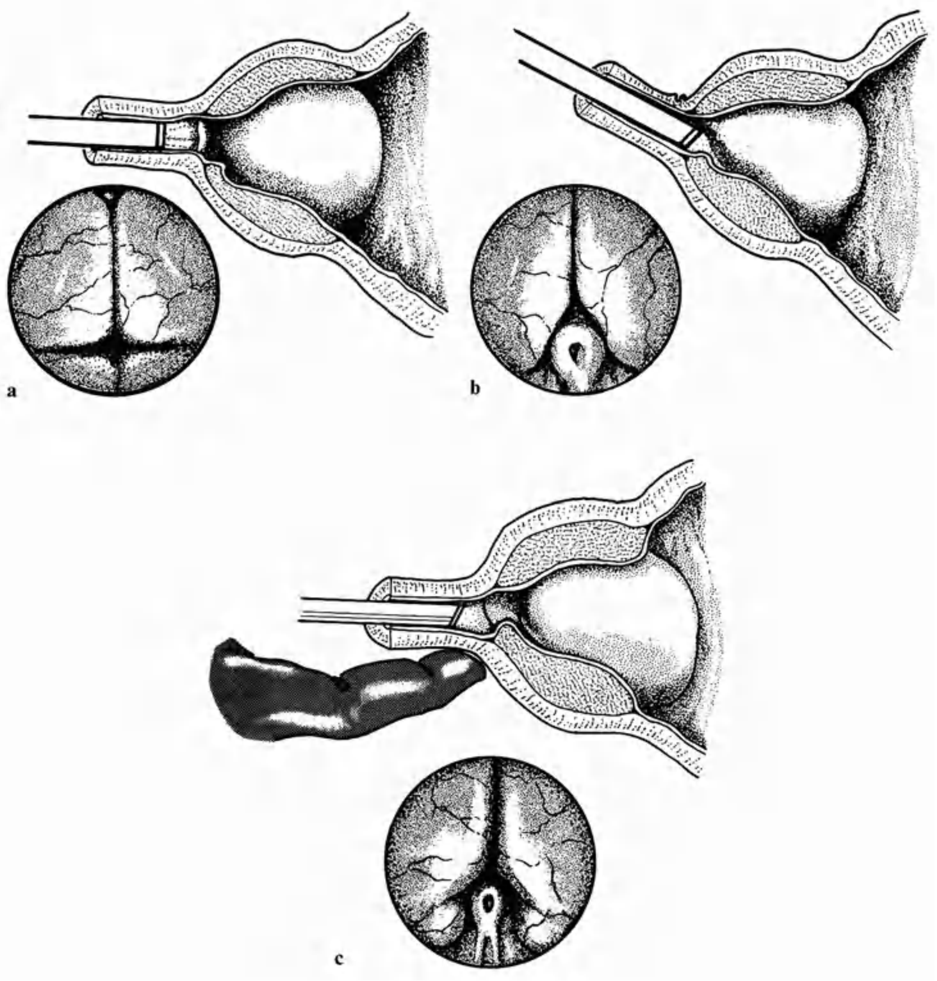


Fig. 77a–c. Demonstration of the poorly visible verumontanum. a With the telescope held in normal horizontal position the verumontanum is invisible lying as it does between two pronounced lateral lobes. The lateral lobes also overhang the verumontanum distally. **b** Marked downward tilt of the telescope within the urethral cleft. The lateral lobes are forced apart and the verumontanum becomes visible. **c** The same effect is achieved if the floor of the prostatic urethra is lifted by a finger in the rectum. The urethra will then open out to reveal the verumontanum. In this position (instrument distal to the prostatic capsule!) the midline limit of the capsule is also palpable

ε) The Topographic Relationship of Verumontanum and Distal Extremity of the Lateral Lobe. Every book or work on transurethral resection presents the verumontanum as *the* ultimate boundary *never* to be transgressed distally. The special significance of this lighthouse warning the seafarer of the reef of incontinence is now to be discussed in greater detail.

The rule is certainly valid in respect of the midline, and the boundary is thus a midline boundary, at 6 o'clock. Careful observation will reveal that, even slightly to either side of this line, a voluminous lateral lobe may considerably overtake the verumontanum distally. The same fact emerges from the study of pathologic specimens and anatomic illustrations. The value of the verumontanum as a landmark is thus slightly reduced, since it becomes *no longer* a universal boundary line *never* to be transgressed. It does, however, remain an extremely important midline landmark to be referred to in a topographically difficult region of paramount importance for the preservation of continence.

The region should thus be inspected with the following questions in mind:

Where is the distal limit of the lateral lobes?

What is the relationship of this limit to the verumontanum?

This clearly requires careful examination of the lateral lobes, which will appear on endoscopy as medially convex tissue masses. Their limit is easily recognized as the point at which this convexity meets the circular cross section of the urethra.

One important aid to understanding the topographic relationships of verumontanum and lateral lobes is the way in which the resectoscope sinks into the cleft between verumontanum and lateral lobe, as seen in Plate II (Illustration 8). The convexity of the lateral lobe may be seen extending distally beyond the verumontanum. The same cleft is visualized in Illustration 7 in the same plate. The significance of this arrangement for surgery may be appreciated from Plate X (Illustrations 56 and 58), where it is particularly obvious that the lateral lobes terminate distal to the verumontanum. In Illustrations 55 and 57 (Plate X) the instrument has been dipped down into the cleft and is pushing the lateral lobe vestige away, thus demonstrating the boundaries for resection.

Aids to understanding this relationship. The verumontanum and the distal end of the lateral lobe may be easily visualized either by pressing the resectoscope sheath into the depths of the urethral cleft, or equally by the palpating finger lifting up the floor of the prostatic capsule. Both techniques have been described above (p. 111) and are further illustrated in Fig. 77.

f) The External Sphincter

α) Initial Anatomical Considerations. The phrase "external sphincter" has become so indigenous to urologic literature as to be a definite technical term, although the structures designated as external sphincter in a variety of drawings are often only partly correct in their anatomic representation. TANAGHO and SMITH (1966) went to great pains to clarify this question and their careful histologic studies revealed an entity consisting of mixed striated and smooth muscle fibers connected to the prostatic capsule. The concept of a circular ring muscle should thus be abandoned, despite the considerable clinical evidence for such an assumption.

The same fact may be demonstrated by endoscopic examination of this region in unanesthetized patients who are voluntarily able to contract this muscle structure to command. We know, however, that this voluntary muscle is not solely responsible for continence, a clinical observation which has been substantiated by urodynamic investigation of partially continent patients who are well able to interrupt their urinary stream for a short period of time, but nonetheless remain incontinent despite the demonstrable function of this voluntary apparatus. It is most probable that continence further requires the activity of an involuntary muscle system. It would seem that the endoscopically observable response to the faradic test of TAMMEN and HARTUNG (1973, 1976) represents the contraction of smooth and striated muscle fibers to simultaneous stimulation.

It may be that the entity examined by the hydraulic sphincter test of HARTUNG (1979) is merely the resting tone of these groups of muscles which had been opposed throughout the endoscopic procedure by the flow of irrigating fluid and were then seen to return to their resting position on reduction of hydrostatic pressure. These matters are not fully understood and remain the subject of further studies. The great interest in the external sphincter derives from its importance as a bladder outflow control. It is because of this function that it remains a boundary of overriding significance in transurethral surgery.

β) Endoscopic Appearance of the External Sphincter Region. An external sphincter itself cannot be visualized endoscopically, only the region in which contractile elements are found. For this purpose three methods are available:

1. Examination of this region in the unanesthetized patient (neither general nor regional anesthesia, merely local anesthetic of the urethral mucosa)
2. Faradic stimulation of the external sphincter region (TAMMEN and HARTUNG 1973, 1976)
3. Hydraulic stimulation of the region (HARTUNG 1979)

The recognition of fine detail is further impeded if the patient has had an indwelling catheter for a long enough period to cause urethral mucosal edema.

If, in the unanesthetized patient, the instrument is gradually withdrawn from the prostatic urethra, the verumontanum is the first structure to emerge, occasionally heralded by the urethral crest (see Plate II, Illustration 9), a fine linear elevation of the mucosa blending with the verumontanum only to re-emerge from it distally. The floor of the prostatic urethra then sinks gently away dorsally, to rise up again a few millimeters lower. If the instrument is gently pushed in and out, a fine wrinkling of the mucosa may be provoked distal to the verumontanum. This wrinkling has been called the Nesbit sign.

In fact wrinkling was originally described by NESBIT himself as a ventral landmark only (see Plate I, Illustrations 1, 4 and 5).

A totally different appearance may be found in larger hyperplastic glands, since the distal extent of the lateral lobes may almost completely cover the verumontanum and markedly alter the urethral profile. This effacement may so alter the appearance that the typical surface markings of the normal urethra or of that found in small adenomas may be totally unrecognizable. In these cases the techniques of hydraulic and faradic stimulation, to be described below, may be helpful in identifying the external sphincter apparatus.

The contractile portion of the urethra is generally seen far more distally than was previously assumed. A proximal limit is not easily recognized if the cutting loop, by which the faradic stimulus is applied, is held too far distally, since the contracting urethra will then obscure the forward view. A careful

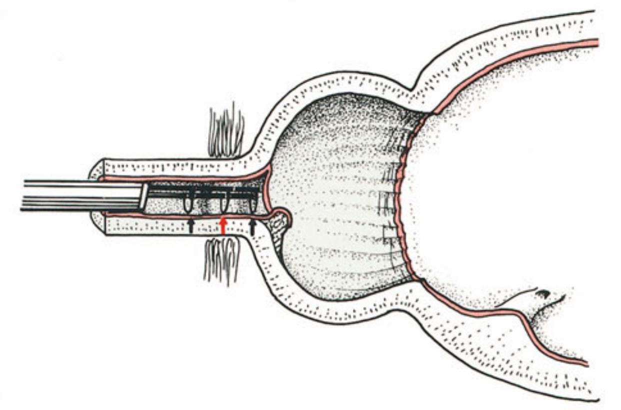


Fig. 78. Testing the sphincter by the technique of Tammen and Hartung. Diagrammatic sagittal section of the prostatic capsule and proximal (membranous) urethra. By means of a changeover switch the cutting loop has been connected to a faradic stimulating current. By sweeping the regions containing contractile sphincter elements, i.e., distal to the verumontanum, contraction may be initiated over a 1–2.5 cm segment of urethra. It is remarkable how frequently this segment is distal to where one might expect

gradual approach to this limit is therefore necessary. I personally have never identified sphincteric fibers with absolute certainty during operation.

γ) Further Aids to Recognition of the Sphincter Region. Rectal palpation while resecting in this region may be of some help in identifying the boundary between capsule and membranous urethra, but only if the instrument is withdrawn distally from the prostatic into the membranous urethra. The midline margin of the capsule then becomes palpable, having previously been obliterated by the distortion introduced into the urethra by the presence of the resectoscope sheath. Palpation remains a somewhat unreliable aid allowing only approximate orientation.

δ) The Sphincter Test of Tammen. TAMMEN developed his sphincteric test in 1973 in our department (TAMMEN and HARTUNG 1973, 1976). He exploited the simple concept that any musculature involved in closing the bladder outlet must be susceptible to faradic stimulation and may therefore be made to contract.

By means of an additional footswitch, a stimulus generator (which may be integrated into the high frequency diathermy unit) is able to provide a stimulating current in the resectoscope loop. Using this current the cutting loop can scan the posterior urethra and establish the region in which contractions may be brought about (Fig. 78). Precise information is then available which enables contractile elements to be spared from resection. Incipient closure of the urethra is clearly seen in Illustration 83; Illustration 84 (Plate XIV) shows complete closure.

The stimulating unit and its connection to the diathermy are illustrated in Fig. 79.

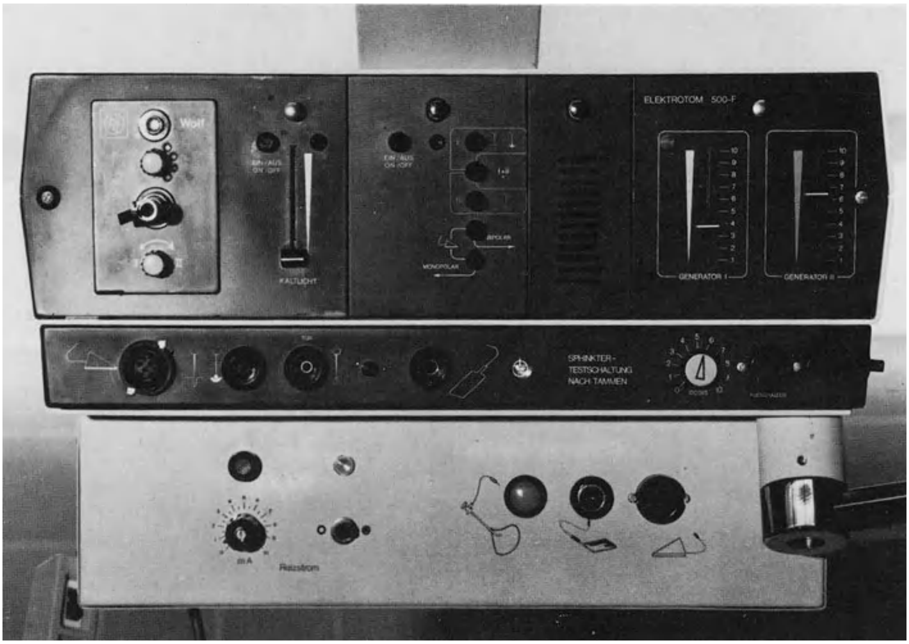


Fig. 79. The Tammen stimulating unit

ε) The Sphincter Test of Hartung. HARTUNG (1979) introduced a practical improvement on faradic stimulation alone by testing the resting tone of the sphincter by means of a short on-off cycle of irrigation flow. If the region distal to the verumontanum is observed under conditions of maximum irrigation inflow, this portion of the urethra will be filled and distended under hydrostatic pressure. When the irrigation hose is then rapidly pinched off, the external sphincter will return to its "natural" position, i.e., it will resume its normal tone and thus somewhat impinge on the lumen of the urethra. This movement may be easily and repeatedly produced by rapidly pinching and releasing the hose. It is important that the bladder should not be overfilled and be able to accommodate irrigation fluid, since the flow will otherwise be too slow and the phenomenon refractory.

This dynamic method of examining the membranous urethra so sharpens one's perception of the normal structures in the region that one is soon able to recognize the slight bulge of the sphincter margin without this "irrigation test." Distal to the lower limit of convexly bulging adenoma nodules a discrete narrowing of the urethra may be seen.

g) The Internal Urinary Meatus

Because of the manifold patterns of median and lateral lobe enlargement, this proximal boundary of the operating field is of particularly varied appearance.

Between the extremes of a simple transition to the bladder, e.g., a transverse bar and massive trilobed hyperplasia of the gland, there are a variety of transitional types requiring careful study and preoperative recognition.

At this juncture the relationship of internal meatus to the ureteric orifices must be carefully examined, both in the distended and the empty bladder.

Finally, attention should be directed to the internal sphincter ring, which may constrict the endoprostatic and endovesical parts of the gland to a varying extent.

α) The Internal Meatus in Small Adenoma, Bladder Neck Fibrosis, and Transverse Bar. In these cases the arrangement is not dissimilar to normal. The instrument slides over a more or less pronounced transverse fold delineating the prostatic urethra from the bladder. This annular aperture is more easily perceived as a "bar" by telescopes with a somewhat angulated axis directed toward the bladder base. Lens systems providing complete forward viewing normally also visualize the ventral aspect of the sphincter-like constriction between urethra and bladder. The best impression of this region may be gained when examining the bladder through a suprapubic cystotomy, where this very small aperture with its funnel-like inlet may be easily seen in the base of the bladder. That is also the appearance of the internal meatus when the bladder is open. A forward-viewing telescope also enables the bladder base and both ureteric orifices to be seen without marked tilting of the instrument towards the bladder base.

Fibrosis of the sphincter sometimes has its own characteristic appearance. The mucosa on the markedly rigid summit of the internal meatus is pallid and devoid of obvious blood supply. The toughness of this region is easily appreciated as the instrument glides over it. Morphologic differentiation of sphincter fibrosis and so-called transverse bar, i.e., isolated hyperplasia of the median lobe, may present considerable difficulties. The general impression is that the tissue of sphincter fibrosis is considerably tougher and the narrowing of the bladder neck somewhat less pronounced. In cases of transverse bar, on the other hand, the changes in the bladder neck are more substantial, more voluminous and correspondingly softer (Fig. 80). These differences are not, however, so pronounced as to allow exact clinical diagnosis, and the results of histologic examination must be awaited.

β) Endourethral Hyperplasia. This corresponds to "Type 2" of TANDLER and ZUCKERKANDL (1922). The hyperplastic tissue mass is situated within the prostatic capsule, although negligible portions may protrude into the bladder (Fig. 81). This form of tumor growth is characterized by the excellent view of the bladder obtainable from the internal meatus. A side viewing telescope gives clear access to the side walls of the bladder without obstruction by hyperplastic tissue. The appearance of the internal meatus would at first seem similar to the previously described types, the difference being in the length of the bladder neck. Examination of the internal meatus by the suprapubic route would then reveal merely a discrete bulging of the immediate vicinity of the internal urethral

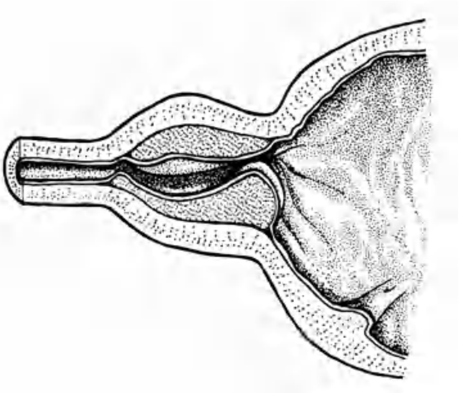


Fig. 80. Diagrammatic sagittal section of distal bladder and prostatic capsule. In this illustration there is sparse hyperplastic tissue. Only at the internal meatus is there some elevation of the prostatic urethra, appearing endoscopically as a transverse bar of whitish consistency. This pallid appearance of the tissue is due to its high proportion of connective tissue and consequent low vascularity

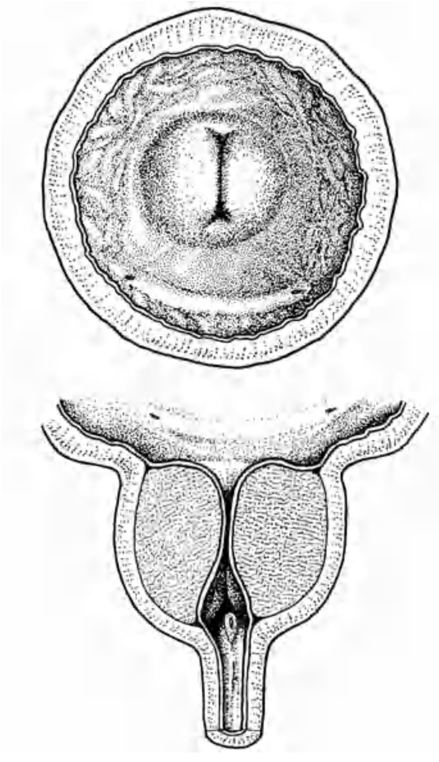


Fig. 81. Appearance of chiefly urethral hyperplasia. Diagrammatic cross section of the bladder (*above*) and coronal section through distal bladder and prostatic capsule (*below*). The adenoma bulges only slightly into the bladder, and there is thus only mild elevation of the bladder base in the region of the prostate

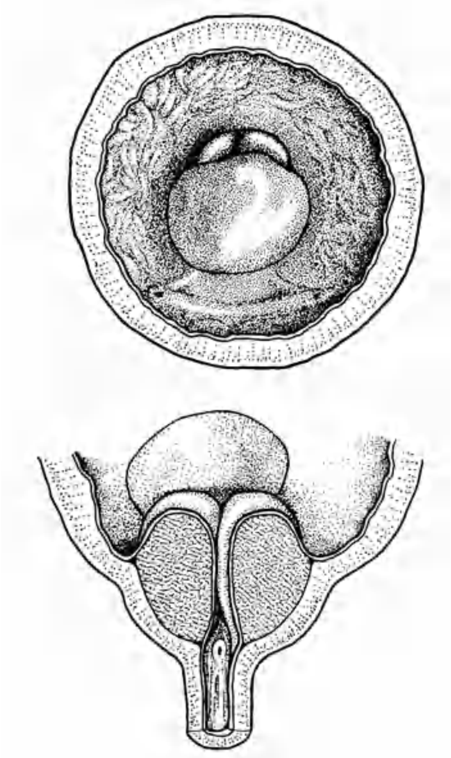


Fig. 82. Appearance of mainly endovesical hyperplasia. Diagrammatic cross section through the bladder (*above*) and coronal section through distal bladder and prostate (*below*). In this example more than two-thirds of the tumor is within the bladder, while the capsule contains only a small proportion of the hyperplastic tissue. Such median lobes may sometimes develop to considerable volumes, often treated by suprapubic enucleation, although precisely this type of hyperplasia affecting the floor of the prostatic urethra and the bladder base is particularly suitable for transurethral resection, even by beginners (see also Figs. 63 and 85)

orifice together with elevation of the entire bladder base. In pure examples of this type of growth, no adenoma tissue projects into the bladder.

γ) Endovesical Hyperplasia. This growth pattern corresponds to "Type 1" of the Tandler and Zuckerkandl classification. The adenoma has grown up through the limiting ring of the internal sphincter and extends up into the bladder (Fig. 82). Both lateral and median lobes may be involved in this process. Such a classification does not, however, mean that little or no hyperplastic tissue is to be found within the prostatic capsule. There is rather a growth pattern in which the internal sphincter constricts the elongated growth in an hourglass fashion and thus separates it into an endourethral and endovesical portion. This constriction groove may be confirmed by the examination of enucleated specimens, and its presence should equally be appreciated during transurethral dissection. It is essential to diagnose this state of affairs prior to operation, since such an anatomic arrangement requires a totally different operative technique (Fig. 83).

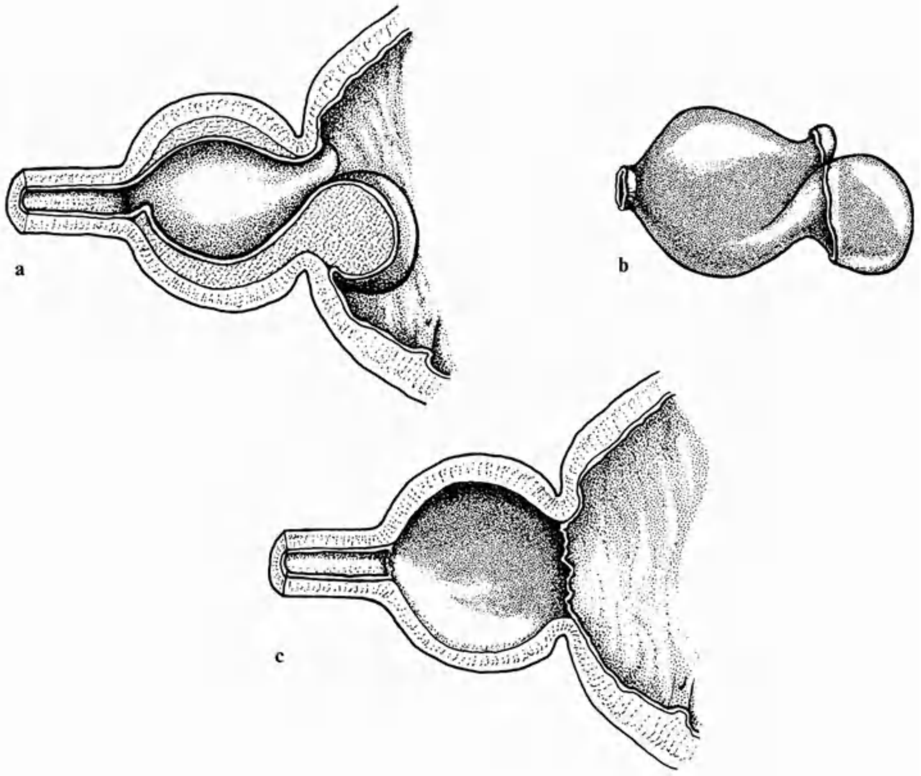


Fig. 83a–c. Sagittal section through prostatic capsule before and after enucleation of an adenoma (with specimen). **a** Section through the capsule with marked median lobe. **b** Operative specimen following enucleation. Note the marked "waisting" of the specimen at the point where its development was hindered by the internal sphincter. Somewhat proximally note the separated margin of mucosa clothing the endovesical moiety of the tumor. **c** Empty capsule. Constriction of the internal sphincter region is clearly seen. These three illustrations are to remind the operator how restricted the lumen of the internal meatus may be. When hollowing out the capsule this state of affairs deserves particular attention so as to avoid perforation of the vesicoprostatic junction

This preoperative diagnosis is easily reached by the use of a wide-angle diagnostic telescope. The ventral and lateral walls, as well as the bladder base, are now no longer so easily seen, being partly obscured by adenoma tissue projecting into the bladder. Predominant median lobe hyperplasia may render the entire bladder base and interureteric ridge invisible, while concurrent lateral lobe development will rather obscure the lateral parts of the bladder (Fig. 84). In such cases a retrograde-viewing telescope may clarify the situation, if the operator is at home with the particular characteristics of this system. The perspective from the bladder base renders the appearance of the hyperplastic tissue curiously flat. A normal diagnostic telescope provides a far more plastic but less complete image of the growth. The sensation of depth is further accentuated by the sharp shadows cast in the field of illumination.

The transurethral surgeon must become equally proficient at recognizing this arrangement through the forward-viewing telescope with which he will

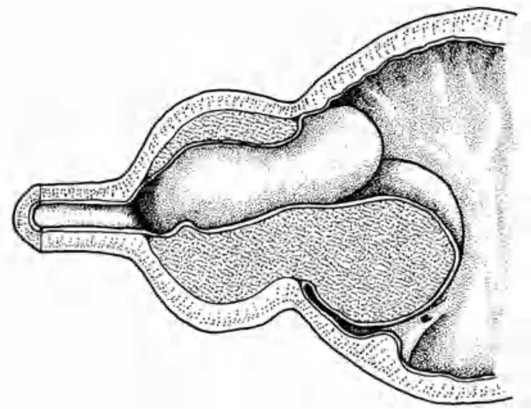


Fig. 84. Marked endovesical median and lateral lobe hyperplasia. The massive median lobe almost completely obscures the interureteric ridge. A 0° telescope is incapable of viewing the ureteric orifices, and this may require a retrograde telescope in a fully distended bladder. The cleft arising between median and lateral lobes is easily seen. The verumontanum lies proximal to the distal ends of the lateral lobes within the prostatic urethra

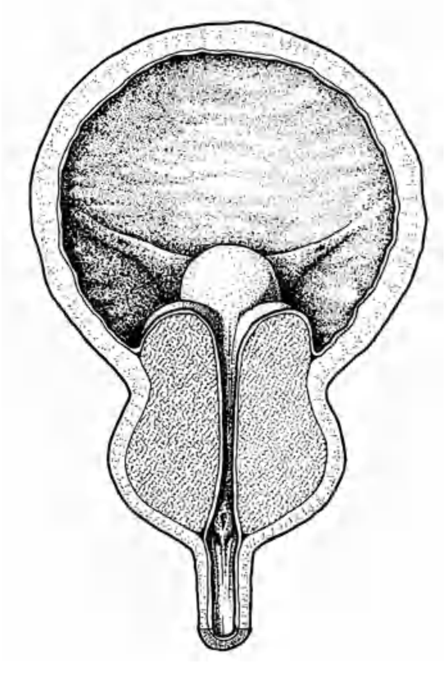


Fig. 85. Typical appearance of trilobe hyperplasia with two lateral and one median lobe projecting well into the bladder. Once again the verumontanum is not the most distal point limiting the field of resection. The lateral lobes extend beyond it distally. The cleft between lateral and median lobes is once more seen

operate. As already pointed out, the beginner should carry out his preoperative examination with the widest variety of telescopes in order to obtain the best three-dimensional concept of the anatomic situation.

Extensive median lobe hyperplasia may further be palpated with the instrument, the sheath being allowed to slide from lateral to medial across the summit of the gland, so as to inspect the often deeply grooved boundaries of the lateral lobe. The instrument is allowed to sink into this "boundary trench", and thus a better view of it is obtained. At the same time an impression is gained of the degree of fixity of the median lobe at its base. Highly mobile lobes tightly constricted by the internal sphincter require a special technique of resection in order to avoid early complete separation of the lobe at its base. The removal of a median lobe floating free in the bladder presents considerable problems.

The same may be said of the lateral lobe.

The commonest form of endovesical growth involves all three lobes and a view from the bladder would then present the typical pattern of trilobe hyperplasia (Fig. 85). As a rule there is a degree of asymmetry, and frequently there is predominance of the median lobe which may amount to over one-quarter of the total amount of tissue removed. Such variations are, however, of themselves of no consequence for operative technique, so long as the bare fact of endovesical hyperplasia is recognized and technique correspondingly adjusted.

h) The Internal Sphincter

This ring of tissue is not, of course, visible during preoperative inspection of the bladder neck, although its size may have been estimated prior to operation. The caliber of the internal urethral orifice, on the other hand, may be definitely determined (Fig. 86). If the instrument is freely mobile at that point,

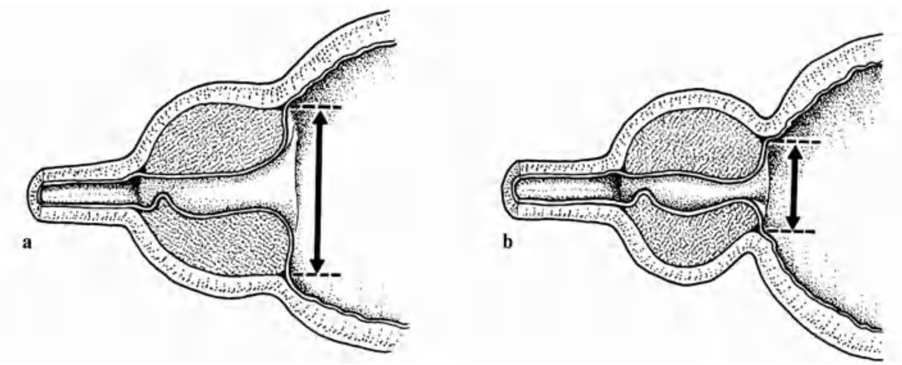


Fig. 86a, b. Internal urethral meatus of varying caliber. Diagrammatic sagittal section through distal bladder and prostatic capsule. **a** The adenoma has stretched both the internal sphincter region and the capsule. In such a case, resection of the endovesical portion of adenoma is easy, since hollowing out of the capsule does not require wide excursions of the instrument. **b** Markedly constricted internal meatus. Resection may be expected to be difficult. Such a constriction is often only vaguely suspected preoperatively but will become apparent after the first few cuts expose the sphincter (see Fig. 83) there can be no significant narrowing of the sphincter, and vice versa. In some cases the internal meatus may be recognized as a broad slit-like opening, and the cleft between the lateral lobes then continues without constriction into the bladder. Such an arrangement will present fewer operative difficulties than does the presence of a true constriction.

Inspection of the prostatic capsule during transvesical enucleation procedures is helpful in understanding the various forms of internal sphincter. The sphincter ring may be so tight that the enucleated tissue can only be extracted from the prostatic capsule with great difficulty, or it may be so broad that the gland may easily slip back into the bladder. Such experience should help to complete the stereoscopic concept of the bladder neck gained during preoperative examination.

i) The Bladder Base and the Retroprostatic Recess

Part and parcel of examination of the internal meatus is an assessment of its relation to the bladder, particularly those regions of the latter adjacent to the operative field.

The depth of the retroprostatic recess is best established using the forward-viewing operating telescope. Examination should start with the bladder empty, so that its behavior in its various regions may be studied as it is gently filled by the irrigating flow.

The retroprostatic recess. As the adenoma grows it leads to changes in the bladder base and internal meatus. This is particularly true of the expanse of bladder base between internal meatus and ureteric orifices.

If the adenoma is small, the transition from urethra to bladder is almost normal, and a forward-viewing telescope gives a good view of bladder base, interureteric ridge and ureteric orifices. A deep recess renders the orifices hard to see (Fig. 87).

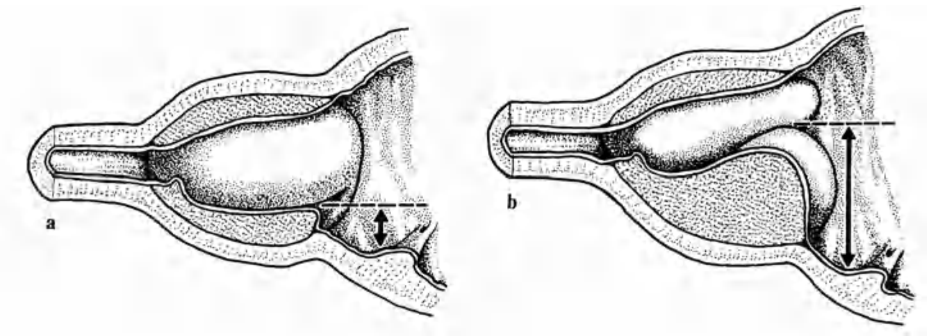


Fig. 87a, b. Shallow and deep retrosprostatic recesses. a There is a short distance from prostatic urethra to bladder base and ureteric orifices. Such a situation is easily recognized endoscopically prior to operation, which should proceed with particular care. **b** Deep recess. A considerable amount of tissue must be removed before the bladder base could come within reach of the resectoscope loop. Tissue may thus be energetically removed during the initial phases of operation

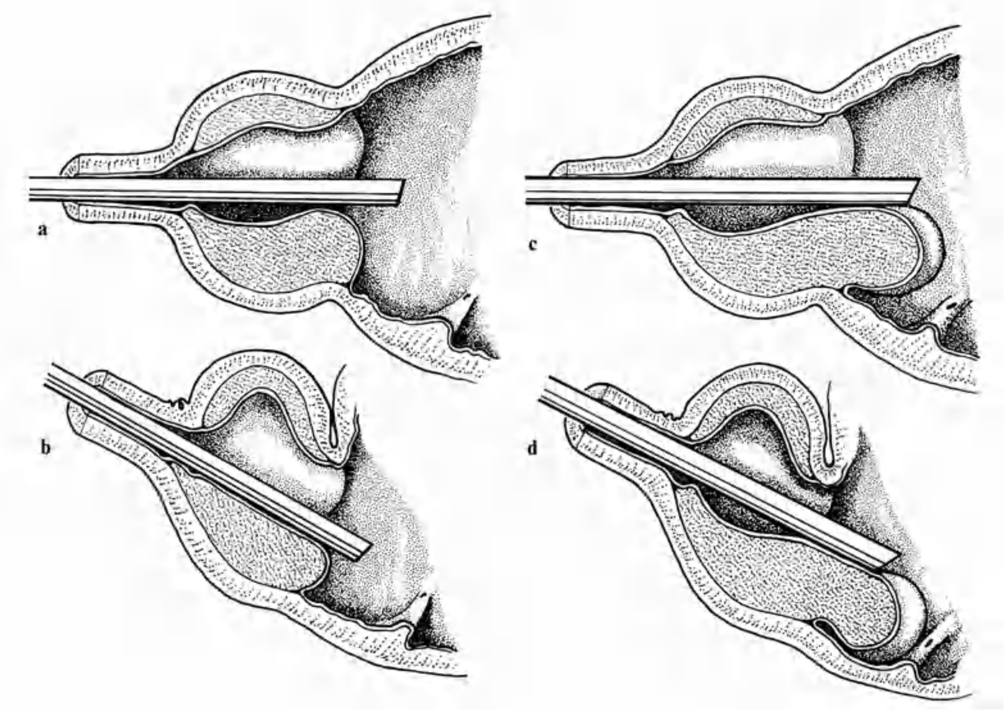


Fig. 88a–d. Visualizing the bladder base in the presence of endovesical adenomas. Sagittal section through distal bladder and prostatic capsule. **a** The instrument lies horizontally in the prostatic urethra. In this position the bladder base is not visible. **b** Instrument tilted down towards bladder base. The interureteric ridge and ureteric orifices may be demonstrated. **c** Instrument in the prostatic urethra in horizontal position. A large median lobe covers the trigone. **d** Downward tilt of the instrument. The median lobe overlies the interureteric ridge and obscures it. Only removal of the median lobe or preoperative use of a retrograde telescope will render the interureteric ridge visible

As the bladder is emptied, the orifices and the bladder base will move toward the internal meatus, whence they will again move away on refilling.

A deeper recess will require that the instrument beak be markedly lowered if the trigone and ureteric orifices are to be seen at all (Fig. 88). In the presence of very large adenomas this may become completely impossible with the forward-viewing telescope and a diagnostic instrument must then be used. It is difficult to classify precisely the different situations which may occur, since there is great variation and an imperceptible transition from one form to another.

A separate problem arises from endovesical hyperplasia, since even a modest but protuberant median lobe will then severely impede examination of the bladder base.

The ease of assessment of the recess and its depth has not proved a useful measure of prostatic size in our hands.

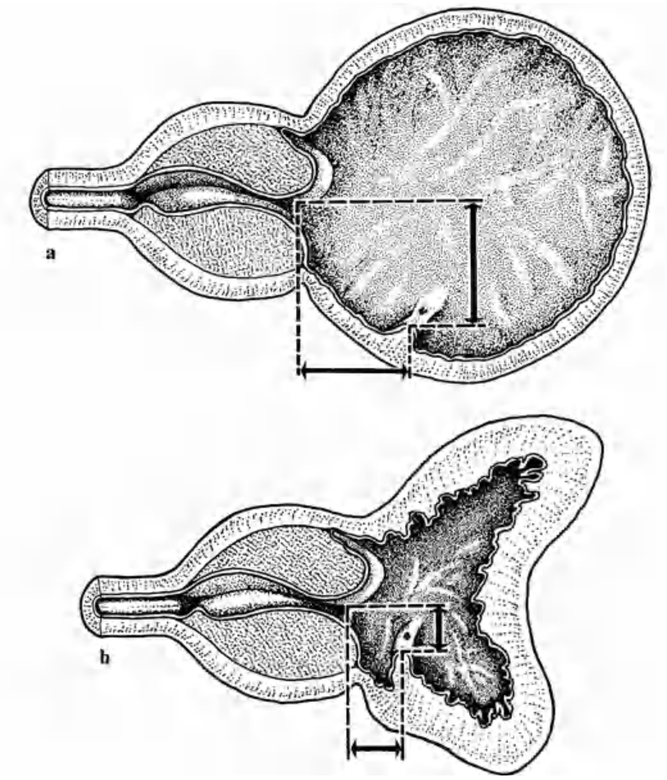


Fig. 89 a, b. Relationship of ureteric orifices to internal meatus in the full and empty bladder. Diagrammatic sagittal section through bladder and prostate. **a** Arrangement with distended bladder. The ureteric orifices and interureteric ridge are separated from the internal meatus both cranially and dorsally. There is thus little danger of accidental damage under these circumstances. **b** Arrangement when the bladder is empty. Interureteric bar and orifices have approached the internal meatus both by caudal descent and ventral elevation. The orifices are thus considerably at risk if this state of affairs goes unrecognized, e.g., if the bladder is excessively emptied by an automatic evacuating device

j) The Urinary Bladder

Wherever a prostatic adenoma (or carcinoma) is to be resected there are two groups of questions to be considered:

1. Incidental finding of bladder disease on endoscopy
2. Relation of the bladder to the operative field

Bladder disease is further considered later in the appropriate section, while topographic relationships to the operative field are properly dealt with in this general anatomic discussion.

α) Incidental Finding of Bladder Disease. Any endoscopic examination of the prostatic urethra must of course incorporate a careful assessment of the bladder. Particular attention should be paid to the use of special telescopes for the examination of that part of the bladder obscured by extensive protrusion of median or lateral lobe tissue into its lumen. Particularly elderly patients may have a high incidence of clinically silent tumors in addition to the prostatic adenoma obstructing their bladder outflow. It would be worse than fatal if a small tumor, probably amenable to curative resection, were so long overlooked as to subsequently present at an inoperable stage. The same is true of bladder diverticula and bladder calculi, to mention only the more frequently found concomitant pathologies.

β) Relation of the Bladder to the Operative Field. The bladder is the immediate relation of the bladder neck, and examination of the operative field proper should always incorporate an examination of the bladder in the various degrees of distension likely to be encountered during the procedure.

In particular, the way in which the shape of the bladder changes as a function of filling may be carefully studied during this preliminary examination. It will then be appreciated how the trigone and interureteric ridge of the empty bladder closely approach the internal meatus, both as a result of elevation of the bladder base and of actual approximation, as demonstrated in Fig. 89. The wall of the empty bladder may actually lie in intimate contact with an extensive endovesical adenoma. In such a case, the bladder wall is at risk during resection of this moiety, unless preliminary examination has firmly implanted such a danger in the surgeon's mind.

The less experienced operator is also strongly advised to measure the bladder capacity, so as to be aware of the available duration of an individual cutting run.

Chapter D

General Resection Technique Cutting Methods and Techniques

I. Introduction

Electroresection is a highly developed operative technique in which a number of individual manual maneuvers must be coordinated to a meaningful pattern of work. Control of the irrigating flow, application of cutting and coagulating current, operation of the electrotome and last but not least a general sense of being at home in the endoscopic field only become an automatic sequence of reflex actions at the end of a long period of training. For this reason a number of authors have recommended the use of teaching phantoms, such as a clay model (PIRKMAYER and LEUSCH 1977), a cow's udder (HABIB et al. 1975) or bovine heart (CONGER 1963). For a variety of organizational reasons we have so far managed without such practice equipment and manage to train young surgeons by a process of careful and stepwise introduction to operative technique (see p.). This requires a great deal of patience on both sides. Twenty-five years of experience in the training of young urologists has taught me the fundamental importance of becoming completely accustomed to *one* instrument. After all, a driving pupil or student pilot would be expected to at first practice his technique on a single type. NESBIT (1954) has explained this in graphic terms:

"With such a variety of instruments presently available the urologist can select the type that best suits his temperament and needs. But the neophyte resectionist should not hope to supplant dexterity by ingenuity of instrument design; or a carefully acquired technique by automatic machinery. Duffers at golf do not shoot par by the purchase of fancy clubs."

A further point should be made by way of introduction: the younger a person who wishes to learn the technique of resection, the greater the chance that he will rapidly acquire a good standard of proficiency. If a urologist of 50 or more belatedly recognizes the gap in his education and then expects that, due to his experience, he will easily master this technique, he should realize that the majority of such attempts end in only a moderate degree of success. Of course there are individual exceptions, but the difficulties will be considerably greater for the older man. Detailed knowledge of the instrument set for transurethral surgery is best gained by repeated dismantling and reassembly. The ideal opportunity for this is the cleaning of instruments after surgery. Such knowledge is not only of value for the surgeon working in a well-organized clinic, it is also of fundamental importance to the established urologist providing a specialist service in private clinics where he is unable to rely on a disciplined team of specially trained nurses. A further important aspect of such training is the requirement for the surgeon to be capable of overseeing the whole working of the operating department team in exercising his position of leadership. From this point of view, simple cleaning maneuvers form an invaluable foundation for further procedures. They represent an opportunity to learn the more important maneuvers involved in operating the instrument without the requirement for sterile techniques. The loading of a new cutting loop for example needs to be carried out quickly and with a steady hand. The surgeon himself must be capable of executing these maneuvers with the precision of a steepwalker whenever a gowned scrub nurse happens to be unavailable. This is true not only of changing the loop but for manipulation of all parts of the instrument. By the same token the recognition and correction of small technical defects may be learnt during such a preoperative phase of training. There thus arises a manual intimacy between operator and instrument similar to the basic weapon drill of cleaning and maintaining a rifle in army training. Since the eye is unable to monitor the individual maneuvers during surgery, these must be practiced to the point of automatism. The urologist's fingers, for example, should come to know exactly the position of the irrigation cock lever.

Holding the instrument should also at first be practiced under nonsterile conditions. Single- and two-handed operating, the maneuver of 180° axial rotation, i.e., for resection in the ventral region, need to be tried out and understood. The learner will have an excellent opportunity during the operation to observe these maneuvers in the hands of a practiced surgeon and can then repeat and practice everything for himself as a "dry-run" while cleaning the instruments.

II. Holding the Instrument

1. Two-Handed Technique

This is the more usually practiced way of holding the instrument. The left hand grasps the sheath and the right controls the electrotome and executes cutting movements by operating the loop control mechanism (Fig. 90). The majority of instruments in current use have rings and handles arranged for optimal control of the loop by the right hand. We use an instrument in which a thumb ring is connected to the loop carriage and controls its movements. The other fingers of the right hand are steadied against the outlet port of the sheath or are inserted into an oblong ring upon the resectoscope sheath. According to the particular instrument employed there will be minor variations of technique, but the principle remains the same. Instruments in which loop

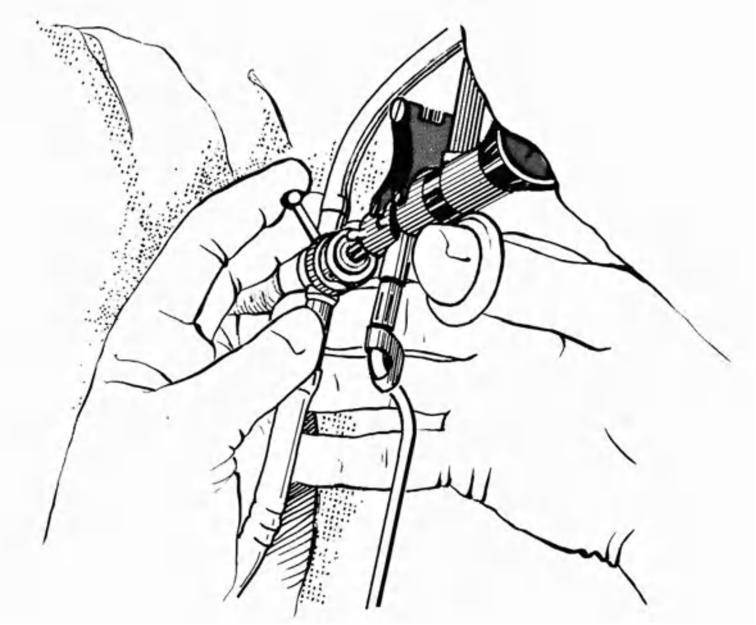


Fig. 90. The instrument held with both hands. The right hand operates the electrotome and supports the instrument during movement and rotation of the instrument which are, however, initiated by the left hand. The left hand operates water inlet and outlet as required by means of the central stopcock. When the electrotome is removed, the thumb of the left hand closes the end of the sheath. Irrigating fluid and resection chips then escape through the drainage port (see Fig. 15)

movements are controlled by rack and pinion, as in the original Stern-McCarthy design, are to some extent an exception.

The left hand holds the resectoscope sheath, and is mainly responsible for advancing and retracting movements as well as actual rotation of the sheath. Furthermore, the left hand is in control of the water supply. Under some circumstances the left hand may also help to steady the resectoscope sheath against the patient's thigh (Fig. 91). This position is of particular value in relation to the short female urethra, when operating through a perineal urethrotomy or when excising tissue from the immediate vicinity of the sphincter, in short wherever particularly fine and carefully controlled cutting is required, e.g., at the prostatic apex.

A different situation arises if the instrument is rotated through 180° into the position for cutting ventral tissue (Fig. 92). This requires a change in the grip and the mind alike. The right hand now controls the electrotome from above while the left hand works the water control, which is now on the right side of the instrument.

Some urologists prefer not to change their grip for ventral operating, but adopt an appropriate posture (Fig. 93). This procedure has the advantage of allowing a rapid return to lateral and dorsal areas of the bladder neck without further shifting one's grip.

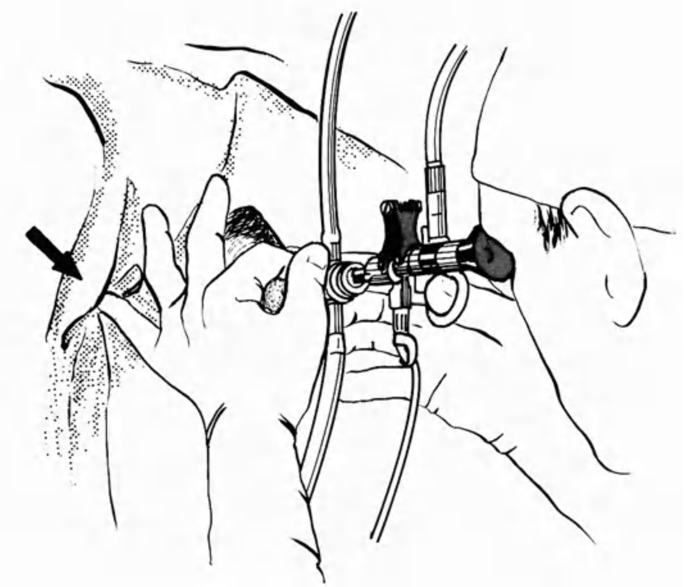


Fig. 91. Two-handed grip on the instrument. The little finger of the left hand is braced against the patient's perineum and so fixes the instrument as to prevent uncontrolled distal movements (protection of the sphincter)

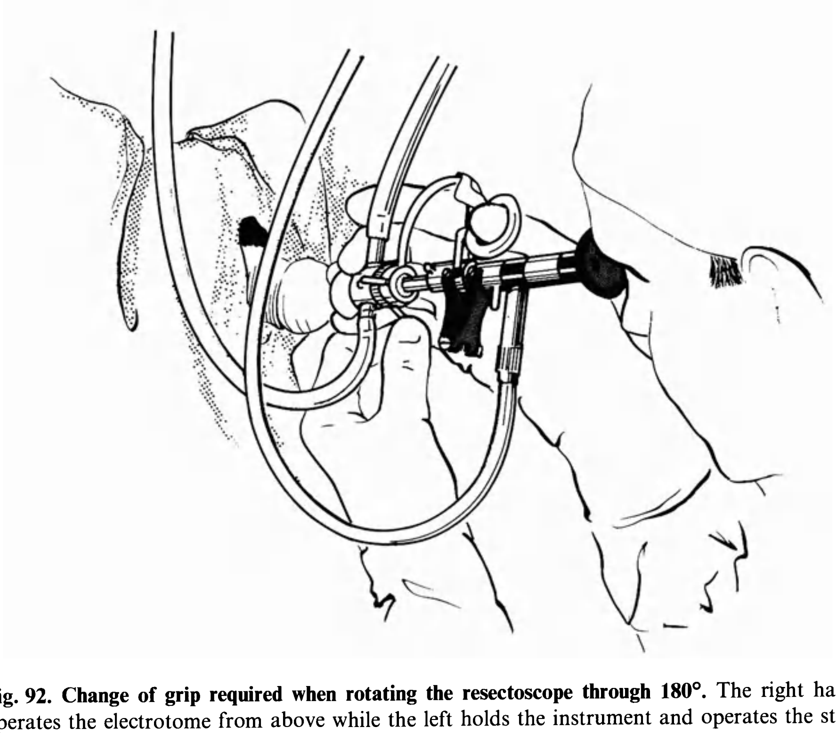


Fig. 92. Change of grip required when rotating the resectoscope through 180°. The right hand now operates the electrotome from above while the left holds the instrument and operates the stopcock. In many cases this position may be used for the resection of tumors of the bladder vault or of ventral portions of the prostate

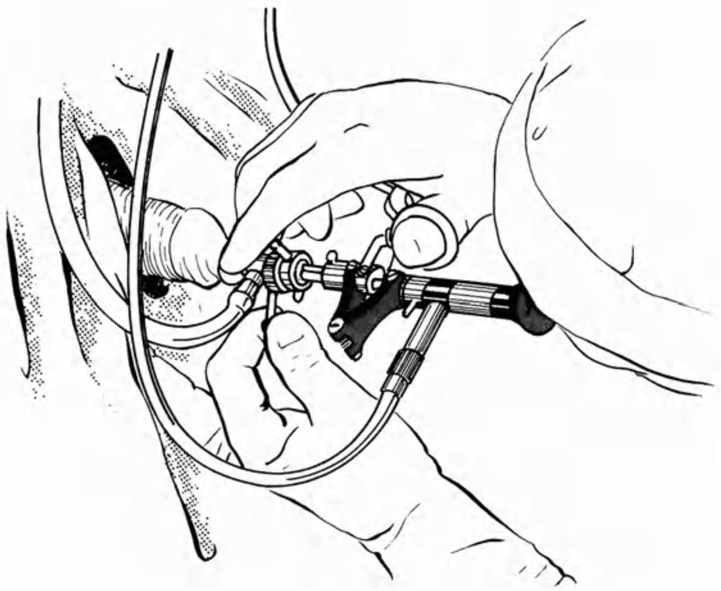


Fig. 93. Alternative change in posture for ventral cutting. Ventral portions of the prostate and the bladder vault may be reached equally well if the operator leans to one side while rotating the instrument into the ventral cutting position without shifting his grip. Many urologists prefer this position, since it permits an uninterrupted transition from dorsal to ventral regions without releasing the instrument

2. Single-Handed Technique

This method is used when resecting basal and apical areas of the gland, if this requires that the capsule be elevated toward the cutting loop by a rectal finger (Fig. 94). Single-handed working may also be necessary if one needs to press the bladder vault or ventral parts of the adenoma toward the resectoscope. In these cases the instrument is operated with the right hand while the left presses down on the vault. At the same time the resectoscope is rotated into an inverted position. Control of irrigation by the cock lever then becomes impossible and thus depends on compressing and releasing the irrigation hose (Fig. 95). These are precisely the phases of operation in which a reduced inflow of water is desirable, since increasing distension will lift the bladder wall up and away from the instrument. Compression of the hose between thumb and index finger allows the flow to be regulated and surgery to be undertaken with a just adequate degree of irrigation. The index finger itself may accompany the other fingers of the left hand in simultaneously pressing down on the abdominal wall. The same technique is useful for ventral lobes protruding into the bladder.

When operating in the normal position, single-handed technique does not allow continuous control of the irrigation, since only the thumb of the rectally

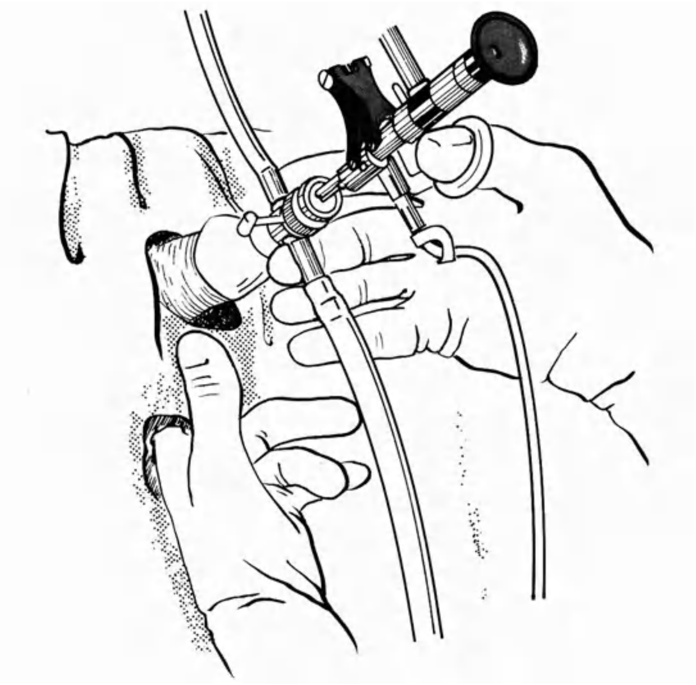
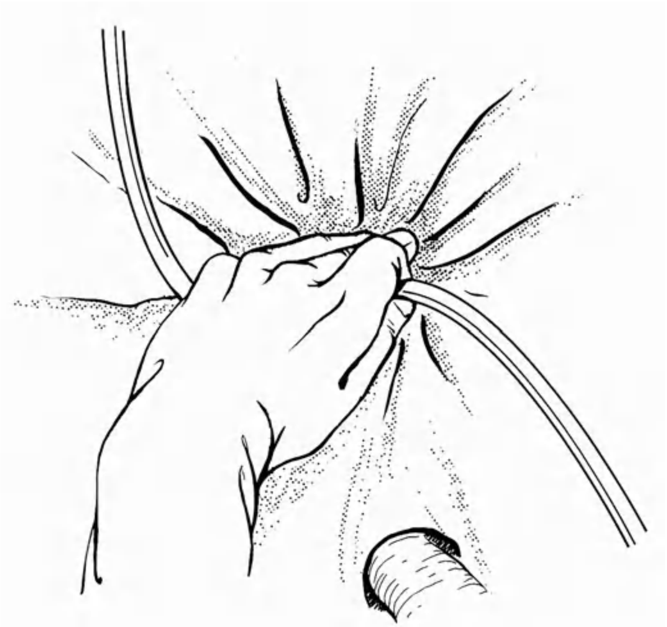


Fig. 94. Single-handed operation of the instrument. The right hand controls the instrument and simultaneously operates the electrotome. The index finger of the left hand is in the rectum and elevates the floor of the prostatic cavity toward the cutting loop



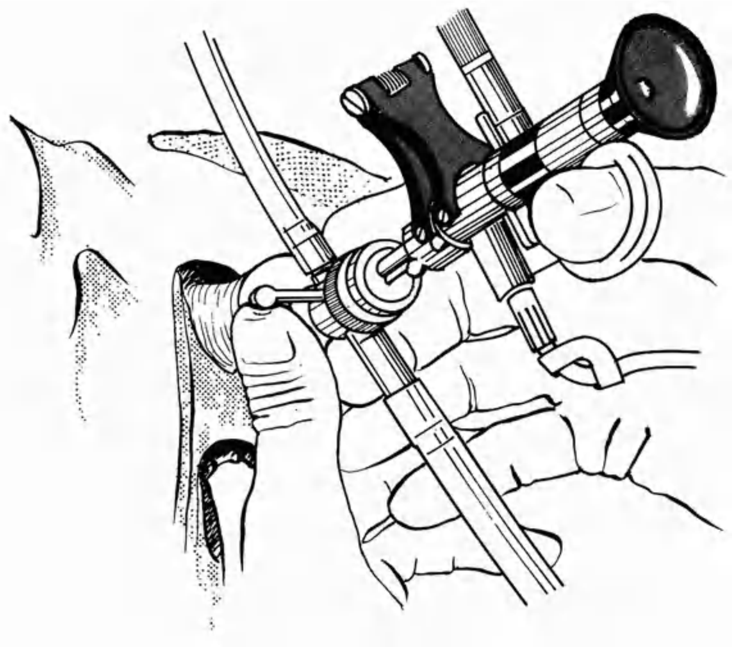


Fig. 96. Regulation of irrigating flow in the single-handed technique. (See also Fig. 94). With this technique it is often difficult to achieve appropriate control of the irrigating flow (increase – decrease). This is easily overcome if the eyepiece of the instrument is gradually lowered until it comes within reach of the left thumb, which is then able to operate the stopcock lever

employed hand is available to control the cock. This requires a brief interruption of cutting, since the lever is only accessible when the sheath is moved over toward the thumb (Fig. 96).

Occasionally, control of irrigating water may be delegated to a suitably dextrous assistant.

III. Irrigation Technique

1. The Irrigation Supply

The following is a discussion of some technical and practical problems of irrigation fluid supply and use.

The purpose of irrigation is to open up the operative field and clear it of blood. Fluid flows from an irrigator suspended above the operating table

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◁ **Fig. 95. Regulation of irrigating flow in the single handed technique.** The irrigating hose is compressed between thumb and index finger of the left hand. The rate of flow is then easily controlled by opening and closing this pinchcock with the thumb. The remaining four fingers of the hand exert pressure on the abdominal wall as required. This counterpressure could equally be provided by an assistant, but this has the disadvantage that every increase or decrease of pressure on the bladder is by instruction, which inhibits rapid coordination of movements

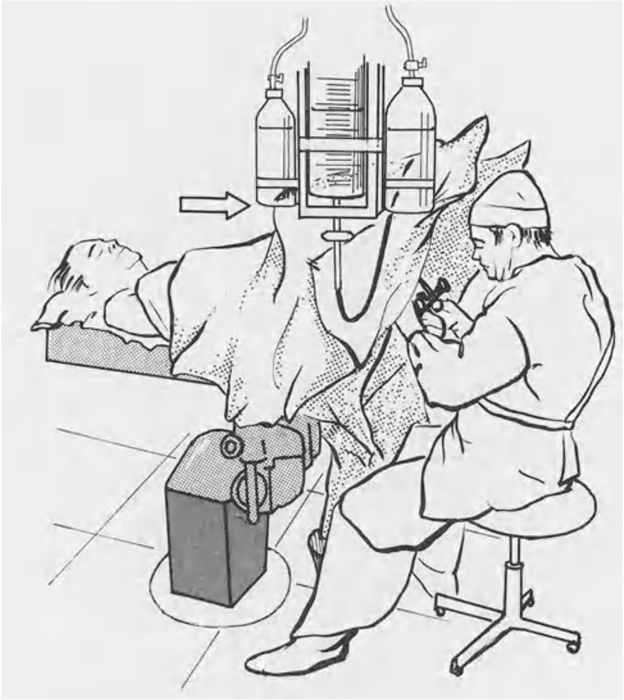


Fig. 97. Adjusting the irrigator height. The average water level should be about 20 cm above the patient's knee. This corresponds to a water head of 60–70 cm

via a sterile hose to a water cock on the resectoscope sheath. Thence it is conducted through the sheath past the electrotome up into the resection field. The volume of irrigating water flowing per unit time will depend on the height at which the container is suspended and on the diameters of the tubing system, which may vary from place to place. The narrowest point is usually the bore of the stopcock on the resectoscope sheath.

The irrigation reservoir should not hang too far above the patient, since the bladder would otherwise fill too rapidly and the pressure within the bladder and the wound cavity rise to unacceptable levels. Such increased intravesical pressure is one of the factors responsible for the intravascular absorption of irrigation fluid into open veins in the resection field.

This latter hazard is greatly reduced if the irrigator hangs only 40–50 cm above the patient. A convenient rule is for the lower edge of the irrigator to be at the patient's knee (Fig. 97). Account must furthermore be taken of the varying water level in the reservoir, which will then vary between 40 and a maximum of 65 cm. This pressure head must sometimes be reduced, e.g., when one or several venous sinuses have been opened or a large abscess incised. The consequent increase in "clearing time" (the time elapsing between introducing the electrotome and the achievement of a clear field) has to be accepted under such circumstances.

There are a variety of practical reasons for not routinely employing a very low irrigation pressure:

1. Clearing of the operative field takes considerably longer.
2. Below a certain pressure head the field of view is cleared only in the center and not around its periphery.
3. Arterial bleeds, even from small vessels, impair the view so badly as to prevent rapid and controlled operating.

For these reasons we have arrived at the previously mentioned compromise level.

As the bladder fills and nears its maximum capacity, the irrigation flow slows up. It reaches zero when endovesical pressure and hydrostatic pressure in the irrigating system are equal. Such a reduction in irrigation flow may be easily recognized by a variety of factors:

1. Resection chips are no longer propelled away from the loop into the bladder at the usual rate.
2. The view deteriorates, especially at the periphery of the field.
3. Even small vessel bleeding is no longer cleared.

With increasing practice one will come to recognize these signs at their earliest stage, when they are a signal to terminate the cutting series. The same may be recognized from pressure curves of the bladder. Experienced operators use less water at a slower flow rate for longer and still end a cutting series before there is a marked rise in intravesical pressure. As already mentioned, the water flow per unit time depends not only on the height of the irrigator but also on the cross-section of the connecting tubes. Since the aim of a perfect technique is to use only as much water as is absolutely necessary, the rate of flow must be regulated to take account of the operative situation. The majority of resectoscopes are so designed as to allow a far greater flow than is truly necessary.

This ability is an asset in emergency situations which may involve profuse hemorrhage. The maximum irrigating flow is then sufficient to maintain a clear field of view until hemostasis is secured. Under normal working conditions the rapid flow of such large volumes of irrigating fluid is not necessary, and the experienced surgeon will "match" the rate of flow to suit the operating condition, allowing good vision without wasting fluid. To this end the rate of flow must continually be adjusted by means of the stopcock provided on every instrument. Generally speaking, an average degree of hemorrhage will require only half the maximum available rate of flow. We have therefore had our routine instrument provided with a half-way mark on the control cock. This is easily felt, since the lever has a slight locating action at this setting. Chapter F deals with the specific problems or irrigating fluid and hemostasis in more detail. The effects of raised intravesical pressure due to overfilling are discussed in the appropriate section (see p. 150).

Some instruments are fitted with an additional small irrigating channel (original Stern-McCarthy instrument) which may be connected to an additional irrigating tube for use in cases requiring particularly rapid flow. BAUMRUCKER (1968) recommends this procedure for excessive bleeding. As already remarked elsewhere, I consider clearing of the operating field to be chiefly a problem of irrigation quality rather than quantity. Even large arteries are easily revealed by the use of certain tricks, although they may spurt straight into the field of view or originate contralaterally and generate vortices on the opposite wall of the capsule (see Chap. F).

For this reason it is also quite incorrect to automatically increase the irrigation setting in order to achieve better visibility. The majority of commercially available instruments nowadays represent such an excellent solution to the question of irrigation quality as to make it quite unnecessary to increase the quantity (the flow per second) or irrigation. One exception to this rule may arise in teaching units: an inexperienced trainee may in a short space of time open a number of arteries without achieving their immediate coagulation. The resulting hemorrhage may then be so profuse that the supervising surgeon has briefly to have the irrigator raised to a higher level. Usually only a few minutes are required to clear the field, and the irrigator may then be lowered to its usual level.

2. Air Bubbles in the Field

Air bubbles in the operating field nearly always originate in the connecting tubing and are carried down the resectoscope sheath by the irrigating current into the field of view, where they come to rest with irritating tenacity.

The physics of gas bubble formation is discussed elsewhere together with a method for avoiding this tiresome phenomenon (see p. 331).

Apart from this fundamental technique for avoiding the occurrence of gas bubbles, a number of tricks are available for reducing bubble formation in the operating field, since a proportion of them arise from the ingress of air into the sheath.

1. Before reintroducing the electrotome into the sheath, the irrigation should be turned fully on. The electrotome is only introduced when irrigating fluid is refluxing out of the sheath.
2. The locking mechanism between electrotome and sheath must be properly closed.
3. If the water connections are fitted with stopcocks, it should be ensured that the latter are sealed in an airtight fashion. Loose cocks will allow the irrigating current to suck in air.
4. The hose connecting irrigator and instrument should from time to time be shaken out with the irrigation *fully* on. During this procedure the electrotome should not be within the sheath.
5. Excessively high settings of cutting or coagulating current may bring about electrolytic decomposition of water that has not been *completely* demineralized. Electrolytes arriving in the vicinity of the cutting loop as a result of blood admixture will further augment this process.
6. The bladder vault should from time to time the evacuated of gas, which is easily achieved by holding the sheath aperture up into the vault during emptying of the bladder. At the same time a hand on the abdominal wall pushes the vault towards the sheath.

7. When using the Iglesias resectoscope, it will suffice to briefly interrupt the flow of water and hold the sheath toward the collected air bubbles. The latter are then sucked down the drainage pathway.
8. A similar procedure is possible with instruments having a central stopcock, since the latter may be briefly switched into drainage position. This process may be carried out under direct vision.
9. Shaking the instrument or intermittent compression of the irrigation supply hose are often helpful.
10. With increasing practice one often becomes so accustomed to individual types of bubble as to tolerate them as easily as one would a resection chip caught up on the loop.

Air bubbles are a particular nuisance whenever a first-class image is required, i.e., for cinematography, photography or video transmission of procedures. Under these circumstances the use of prepacked irrigating fluid may be the only way of avoiding bubble formation.

3. Evacuation of Irrigating Fluid and Resection Chips

The clearing of resection chips and irrigating fluid are discussed here under a single heading, since the two are always carried out simultaneously at operation. It is thus impossible to separate the evacuation of irrigating fluid or of operation debris either in practice or for the purposes of discussion, since the method is one and the same.

Two exceptions should, however, be mentioned – the resection technique employing an irrigating resectoscope and that using a suprapubic drainage trocar. Both techniques originate from the aim of minimizing intraoperative pessage of irrigating fluid into the venous system, and thence from a requirement for the lowest possible irrigator level. For systematic reasons they are therefore considered here together with the various other techniques of irrigating fluid drainage.

a) Standard Drainage Technique

Once the electrotome is removed from the sheath, irrigating fluid and a proportion of the resection debris will flow out (Fig. 98). Care should be taken that the end of the sheath lies free in the bladder and is not pressed against the mucosa on the base of the bladder or elsewhere. The siphon pressure in the drainage pathway would otherwise suck mucosa into the sheath aperture, as evidenced by a sudden reduction in drainage flow. The proper position of the instrument to facilitate washing out of resection chips is achieved if the sheath is held close to the bladder base and horizontal movements of the sheath aperture from one side of the bladder to the other so to speak "sweep" the floor of the bladder, thus extracting a maximum number of chips.

Irrigation fluid and resection chips must then be caught by an assistant holding a container under the end of the sheath. Tissue fragments are separated

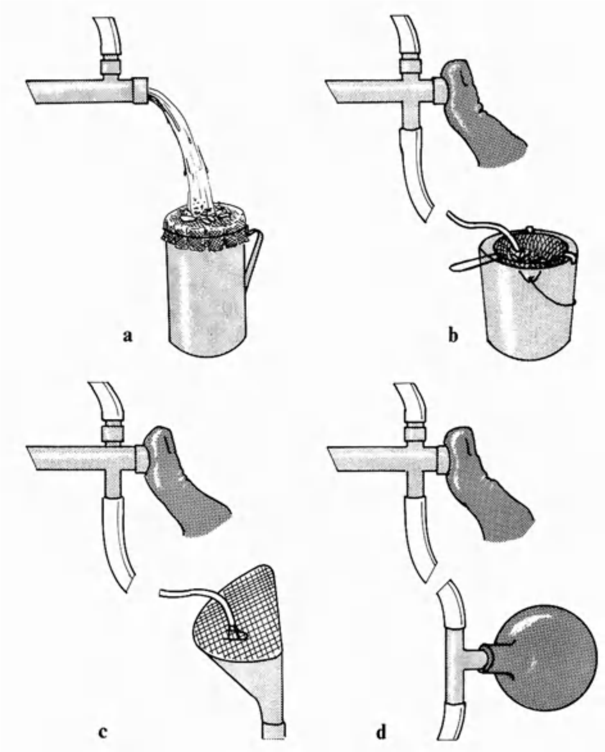


Fig. 98 a–d. Developments in irrigating fluid drainage. a Standard technique. Irrigating fluid runs out of the resectoscope sheath into a container held by an assistant. Gauze across the container separates resection chips from fluid. **b** Outlet of irrigating fluid through a drainage port. The sheath is closed with a finger. Irrigating fluid drains through a long hose into a graduated bucket on the floor. A sieve collects resection chips. **c** Same arrangement as in **b**, with the difference that the drainage hose opens into a sterile funnel mounted on the operating table. **d** Same arrangement as in **c**, but the drainage tube contains an Ellik bulb attached to a T-piece and allowing the evacuation of larger resection fragments

from the liquid either by means of a sieve in this container, or when the fluid is subsequently emptied into a bucket.

This method is the most prevalent, although it is clumsy and requires an additional assistant.

It is also possible to design the operating table so that drained irrigating fluid is caught in a funnel pivoting on the tabletop. Modern drape sets have a fine plastic gauze mesh let in in an appropriate position to be laid over this funnel (Fig. 99). The operator need then only pull the funnel out from under the table toward himself to collect both irrigation and chips. (The operating table and funnel, the use of which we so strongly recommend, have already been described above in Chap. A under the discussion of the operating suite.) Beneath the funnel is placed a container for collecting irrigating fluid for the absolutely necessary purpose of determining blood loss.

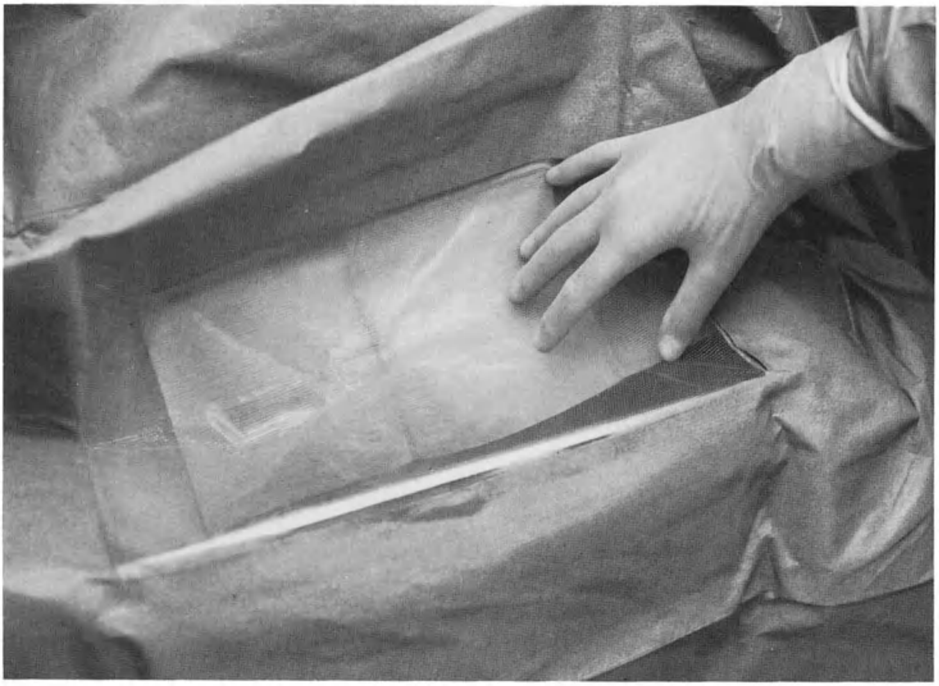


Fig. 99. Special drape used in our unit with a built-in sieve of plastic gauze and laid across the opening of a sterile metal funnel. This lies under the opening of the drain hose. Resection chips are collected within the sterile area and can therefore be handled by the surgeon himself

b) Evacuation by a Drainage Port

To may knowledge this method of irrigating fluid evacuation has two precursors: (1) The THOMPSON punch resectoscope dating to 1935, and (2) the Schulte valve, a drainage tube fitted opposite the inlet port on certain special resectoscope sheaths produced by the Acmi Company.

Both devices allow irrigation fluid to be drained away through a rubber tube attached to this port. After removing the electrotome it is necessary only to close the end of the sheath with a finger, so that irrigation fluid and resection chips alike may be collected without significant flooding of the operating room. The drainage port I described in 1973 is based on the same concept as that of the above-named precursors (Fig. 100).

The drain hose may then be run into a bucket standing on the operating room floor, the chips being collected in an interposed sieve. This form of drainage has the advantage of a long siphon head with consequent improved suction, but the disadvantage that the collecting device lies outwith the sterile area.

In our own practice we use a short drainage hose opening onto a gauze sieve let into the drapes specially designed for transurethral operations (Fig. 101).

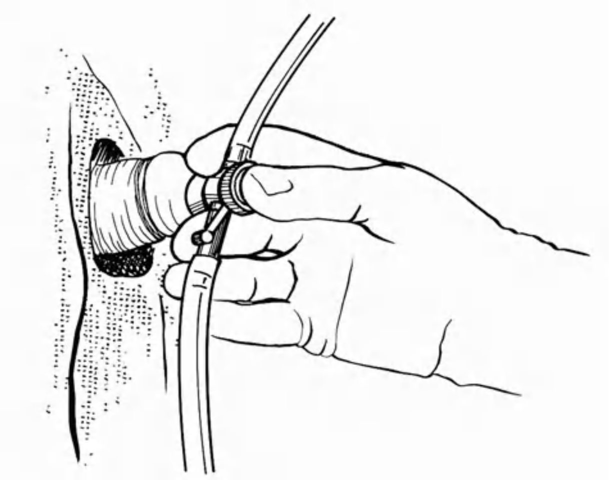


Fig. 100. Irrigation outlet by drainage port. The thumb closes off the resectoscope sheath and the central stopcock is set to the drain position so that irrigating fluid runs through the hose on the outlet port. Horizontal sweeping movements with the sheath facilitate evacuation of resection chips

This enables the surgeon himself to select individual fragments and pieces of tissue for further studies, which is of particular importance during the resection of bladder tumors, since it allows fragments from various tissue planes or special areas of the tumor to be individually analyzed. During resection of prostatic adenomata the basal zone adjacent to the capsule may be studied separately where there is a suspicion of carcinoma.

c) The Collecting Sieve

In order to ensure the collection of individual tissue samples, we have had a special sieve made to fit over the drainage funnel of the Maquet operating table and lie on the sterile drapes. The drainage hose opens onto this device, so that individual fragments may be easily found. The tissue is removed by turning the sieve upside down and tapping it on the sterile instrument trolley. The scrub nurse is then able to pot the various samples ready for dispatch, without further disturbing the surgeon (see Fig. 102).

d) Ellik Bulb in the Drain Hose

Resection of large adenomas or of rigid tissue (carcinoma) often generates sizeable tissue fragments which may block the drain hose. In this situation we have found a simple device most useful. By means of a plastic T-piece we have had a rubber Ellik bulb interposed in the drain hose (Fig. 103). This

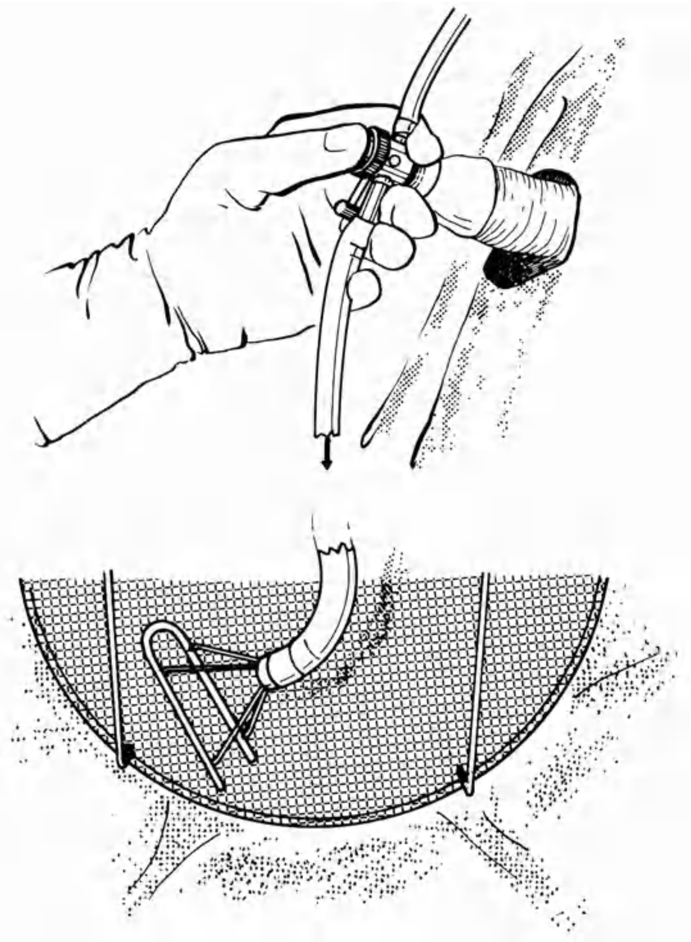


Fig. 101. Technique of evacuation with the drain port. The thumb closes off the resectoscope sheath. Irrigating fluid runs into a metal sieve laid over the collecting funnel of the operating table. A device is attached to the end of the hose so as to weigh it down and yet guarantee free flow of fluid and resection material

bulb is automatically filled by effluxing irrigating fluid. Gentle pumping movements will stir up the tissue fragments and facilitate their drainage. The additional weight of the bulb is barely a hindrance once one has become accustomed to it: one forgets its presence, except to use it when necessary. The device is also of value during punch litholapaxy for the evacuation of calculous debris.

This accessory is always at the ready and we have found its use more convenient than the repeated attachment of a bladder syringe or Ellik evacuator. Considerable time is saved, and it is only rarely necessary to employ an additional metal piston syringe when the method has failed to provide adequately rapid clearance.

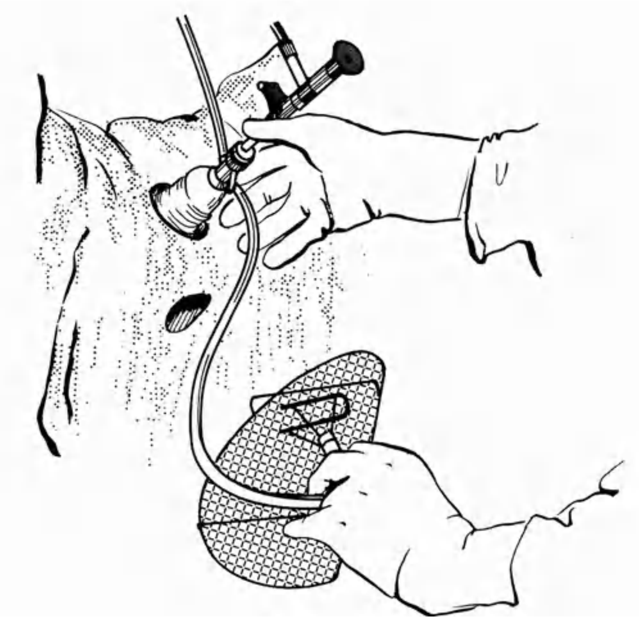


Fig. 102. Extracting a biopsy specimen from the sieve. The surgeon lifts the sieve out of the funnel with his left hand

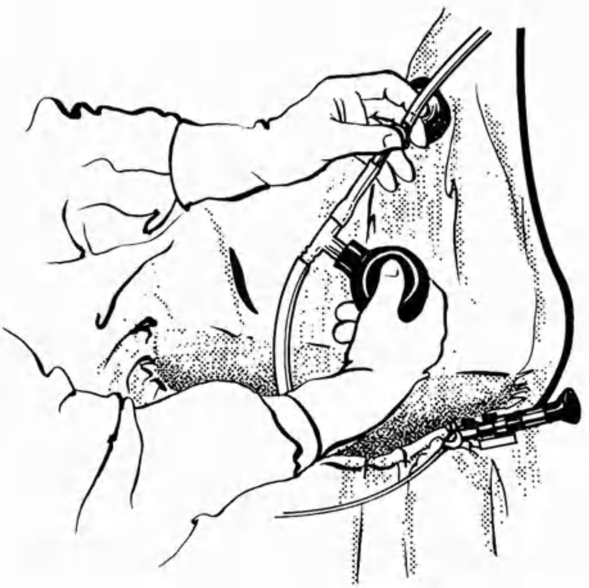


Fig. 103. Ellik bulb in the drain hose. When resecting large adenomas or whenever very hard resection chips accumulate, e.g., in prostatic carcinoma, there is a tendency for the drain hose to become blocked. The provision of such a rubber bulb enables them to be easily evacuated and discharged. This device is also useful for punch litholapaxy, since the attachment of an Ellik evacuator is thus avoided

e) Technique with Central Irrigation Cock

This differs from techniques with previously mentioned instruments chiefly in allowing the drainage of irrigating fluid without removal of the electrotome from the sheath. Under some circumstances this may be a distinct advantage, e.g., when the bladder is too full to allow further coagulation, but a bleeding vessel has been detected at a point where it will not easily be found again. In this situation the instrument may be kept in the required position and water evacuated by means of a central cock, although this may take somewhat longer since the presence of the electrotome within the sheath impedes the flow of liquid. On the other hand, coagulation may recommence immediately the irrigating flow has been restored. A further example is the evacuation of gas and air bubbles from the bladder vault where they tend to collect. They interfere with and hinder surgery in this region of the bladder and may lead to unpleasant side effects. On the one hand, exposure of the cutting loops to air may lead to their rapid burning out, and on the other hand, the dreaded explosion of gas in the vault may occur. Furthermore, the optically active gas-water interface interferes with vision.

The central cock enables bladder vault gas to be evacuated under direct vision while continuing the resection of a bladder vault tumor under a gentle flow of irrigation. This aid is equally useful for operations on the side wall of the bladder. After one or more cuts have been completed the bladder may be progressively emptied under direct vision until the tumor once again comes to lie in an easily accessible position.

f) Drainage by Specially Designed Instruments or Suprapubic Trocar

α) General Considerations. Special comment should be made on two methods of irrigation drainage – that by irrigating resectoscope and that of bladder drainage by suprapubic trocar.

This technique arose from the desirability of maintaining a low pressure of irrigating fluid in bladder and prostatic cavity, so as to prevent any significant entry of irrigation fluid into the venous system of the prostate.

The danger of hemolysis due to irrigation fluid infusion into juxtacapsular veins (venous sinuses) exposed within the prostatic cavity has been established since the classic work of CREEVY (1947). As early as 1948 NESBIT and GLICKMAN (1948) introduced isotonic irrigation with a solution of glycine (aminoacetic acid) as a means of countering this hazard. However, it was not until 1954 that BULKLEY et al. (1954) drew attention to the possibility of intraoperative overhydration of the patient following such inadvertent infusion or irrigating fluid. The related problems were carefully studied by MADSEN (MADSEN and NABER 1973; MADSEN et al. 1969). There is an extensive further bibliography in addition to these authors, emphasizing the concern felt by many urologists about this danger.

In recent years two technical solutions have been proposed in order to minimize or exclude this danger to the patient. There are three theoretical approaches and associated practical solutions:

1. Resection using the IGLESIAS type irrigating resectoscope
2. Resection with additional suprapubic drainage (TRUSS 1968; BERGMANN 1971; ADAIR 1972; REUTER 1974)
3. Resection with low irrigating pressure head

The first two methods require additional technical equipment in the operating room. Unless they are made fool-proof by appropriate check procedures they will have their own additional technical failure and complication rate. The third method is easily employed using instruments of good irrigating capacity but will always be disadvantageous in the presence of profuse hemorrhage, since this will eventually nevertheless require elevation of the irrigator. The exact extent of risk due to irrigation fluid embolism is accorded a varying degree of significance. These remarks concern not hemolytic reaction to distilled water or other nonisotonic solutions but solely the transurethral resection (TUR) syndrome brought about by irrigation fluid infusion via the venous sinuses of the prostatic capsule with consequent water intoxication and hyponatremia. This latter complication was the real basis for recommending the above special procedures during transurethral surgery.

It may be of some interest to note the figures of MELCHIOR et al. (1974), analyzing results and complications of 2223 electroresections.

The complication rate due to "fluid absorption toxicity" lay between 0.2%–1% for glands up to 40 g and increases (as expected!) only where 40 g are exceeded, reaching 5.5% for glands greater than 60 g. The death rate was, however, *unaffected* by the incidence of this complication.

It may be of some interest to note the relationship between TUR syndrome and renal function. Azotemic patients had an incidence of 1.7%, significantly greater than the overall incidence of 0.7% for patients with normal renal function. The ability of the healthy kidney to eliminate intraoperative fluid overload is thus a factor attaining statistical significance. Even in the group with reduced renal function, however, intravascular absorption of irrigation fluid in no case gave rise to serious complications. For 2015 cases published by HOLTGREWE and VALK (1962), colleagues of MELCHIOR, the figures were approximately the same. Only 0.4% of patients undergoing surgery suffered the TUR syndrome (fluid absorption toxicity). In this series there were once again no deaths attributable to this complication. Basic clinical corrective procedures were always effective.

Our own experience over the past 10 years points in the same direction, for we have *never* observed this clinical picture in a single case. Over a long period of time we have documented plasma sodium and hematocrit in all patients undergoing transurethral surgery before, during and after the operation, and on no occasion have we detected a statistically significant change. Indeed, it is a great many years since we had to deal with a clinical case of dilutional hyponatremia, and this in the face of considerable vigilance following the dire warnings in the literature.

It is therefore reasonable in such a situation to carefully consider the cost effectiveness of more expensive modern techniques. It is not after all as simple as merely buying an irrigating resectoscope or draining the irrigating fluid suprapubically from every patient undergoing transurethral surgery.

Both techniques are only of any value if the irrigation flow is controlled by a reliable regulator or assistant. The operator himself is overtaxed by this additional task. One or other measure must be employed to ensure that irrigation fluid is removed from the bladder exactly at the rate at which it is introduced, so that the same low degree of bladder distension is continuously maintained. Outflow obstruction will lead to overfilling and the usual unpleasant consequences of increasing severity the longer it goes unnoticed – which may be a considerable time since the operator will be depending on the drainage system.

The other problem of continuous irrigation, i.e., excessive bladder emptying, may have particularly fatal consequences for the beginner (and therefore his patient) when endovesical lateral lobes are being operated on. The empty and collapsed bladder then comes to lie against the lateral lobe and is inadvertently injured (see Fig. 89b). The above thoughts should in no way be interpreted as a rejection of continuous irrigation, they are merely a consideration of possible and conceivable aspects of operating with either system.

Neither the technique with the irrigating resectoscope nor that of suprapubic evacuation can obviate careful training in basic endoscopic surgical techniques. Whether or not they facilitate this learning process is not yet established. They represent special forms of resection technique with their own specific advantages and disadvantages and both require additional expenditure on equipment or personnel. No doubt excellent results comparable to those of the classic technique are achieved in the hands of those accustomed to their regular use. Rather more questionable is whether transurethral resective surgery would be an imperfect art of increased risk for the patient had these techniques not been invented. The world-wide popularity of the classic technique, especially in the USA, where it was developed and perfected, seems to suggest an answer.

Certainly no one can be spared the toil of training in operative technique by either the conventional or the low pressure irrigation method.

In view of the current significance attached to this whole area a separate section is devoted to each technique.

β) The Iglesias irrigating resectoscope. These instruments are commonly referred to by the collective term Iglesias resectoscopes, although they vary in technical details from manufacturer to manufacturer. The basic principal is common to all (Fig. 104). Irrigating fluid is delivered to the tip of the sheath through a tube surrounding the cutting loop. This inlet tube is mounted on the electrotome and forms an integral structural part of it.

Fine slits around the end of the resectoscope sheath allow irrigating fluid to return via the narrow cylindrical cavity between inlet tube and the inner surface of the sheath. Owing to the narrow cross section of this pathway, evacuation of drainage fluid must be ensured either by the employment of a suction pump or by means of the operating room vacuum line. Supply is by means of the usual irrigator reservoir or by commercially available bags or containers of irrigating fluid.

Inlet and outflow of irrigating fluid must be kept carefully in step, so that the bladder is neither overdistended no collapsed by excessive evacuation with inadequate inflow. The chief source of difficulties is plastering of tissue frag-

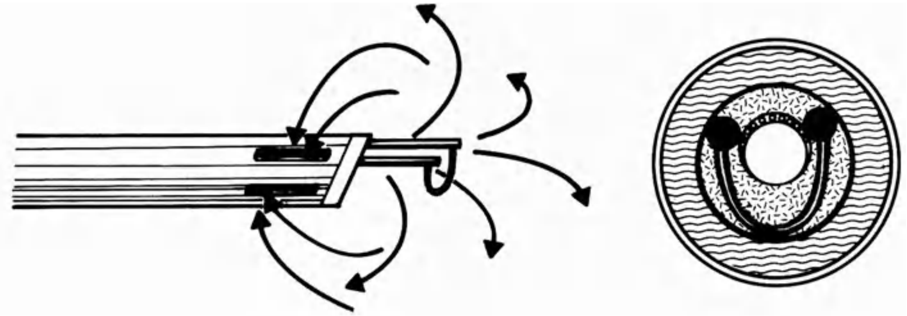


Fig. 104. Resectoscope after Iglesias. This instrument was designed to allow continuous resection without interruption for bladder emptying and to prevent its overdistension. The resectoscope sheath must thus accommodate channels for both water inlet and outflow. The illustration shows the basic design. Irrigating fluid runs into the bladder through a tube surrounding the electrotome. A number of slits in the vesical end of the sheath enable fluid to be aspirated and evacuated by means of a pump through the space between inlet tube and sheath

ments and blood clots against the drainage slits in the resectoscope sheath. In particular, partial blockage of these apertures may lead to gradual and imperceptible overdistension of the bladder.

The most objectionable aspect of our experience with these instruments lies in the difficulty of recognizing severe or even minor hemorrhage during procedures of any real duration. The numerous resection chips collecting on the floor of the prostatic capsule represent a further hindrance.

In the absence of accurate measurements there is no definite foundation for the suggestion that low pressure in the prostatic capsule reduces venous bleeding by 50%, an effect termed "hydraulic hemostasis" by Iglesias himself.

For anybody who has used a standard instrument for any length of time, considerable adaptation is required when working with the irrigating resectoscope.

γ) Resection with Trocar Drainage. The technique of evacuating irrigating fluid via a suprapubic puncture is at least as old as the technique of transurethral resection itself (Fig. 105). In the early days it was far more common to drain cases of chronic retention with marked bladder distension by means of a suprapubic cather than is now the case. It was, therefore, customary to connect the suprapubic catheter to a drainage tube and thus evacuate irrigating fluids. I remember this technique being employed in the 1950s, when it was often employed in May's urology clinic in Munich. Reuter (1974) reports similar experience when working under Hoesel at the urology clinic in Ulm.

In more recent years, Truss (1968) described suprapubic puncture performed specifically with a view to TUR. In the US literature, Adair (1972) describes this method employing a special instrument. Reuter (1980) has followed Bergmann (1971) in adopting this technique and indeed devotes a specific section to it in his monograph.

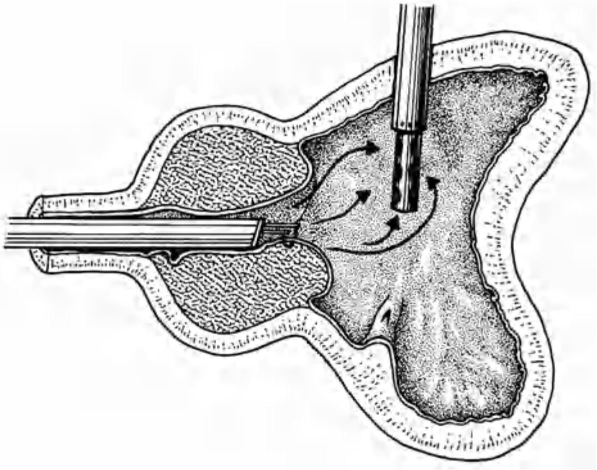


Fig. 105. Resection using a suprapubic trocar. Irrigating fluid runs in through the resectoscope sheath in the usual fashion but is continually evacuated by means of a suprapubic trocar. The trocar must be connected to a vacuum bottle (piped vacuum) or aspirating pump (peristaltic or venturi pump)

Once again the technique originates from the desirability of holding intravesical and, therefore, intracapsular, pressure at the lowest possible level with a view to preventing the incorporation of irrigating fluid. For this reason the preliminary considerations set out at the beginning of the present section hold equally good for this technique.

A factor in favor of suprapubic irrigation fluid drainage is the avoidance of any alterations to the resectoscope or tampering with the careful tuning of the irrigation inlet system. The problems we have encountered in recognizing significant hemorrhage using various types of irrigating resectoscope also indicates the advantage of suprapubic evacuation.

Furthermore, the suprapubic trocar required by this system may subsequently be used for the placement of a suprapubic catheter for early postoperative drainage. This may be desirable in the occasional case of treatment-resistant urinary infection.

The assertion of IGLESIAS et al. (1977) that low pressure resection results in reduced hemorrhage due to "hydraulic hemostasis" is equally unproven in the version stated by REUTER for trocar drainage. As long as comparative blood loss measurements for various techniques of resection remain unavailable, one can only consider these remarks to be clinical impressions.

The arguments put forward by way of introduction (see p. 146) are particularly true for the trocar drainage technique since the required suprapubic bladder puncture represents an additional procedure. Prevention of an easily controlled, and incidentally rare, complication should not necessitate subjecting all patients undergoing transurethral prostatic surgery to temporary suprapubic drainage.

If ever, this might only arise where tumors in excess of 50 g are to be resected, but the majority of transurethral surgeons will anyway decline to operate endoscopically on such cases.

g) Urodynamic Aspects of High and Low Pressure Irrigation During Transurethral Prostatic Resection

By W. Schütz

High and low pressure irrigation are the two alternative techniques available during transurethral prostatic surgery. Their chief difference lies in the intraoperative pressures developed in the prostatic bed and the bladder. In high pressure irrigation the irrigating fluid required to maintain a clear operating field runs into the bladder under gravity. Rising intravesical pressure reduces the rate of flow, and when irrigator pressure has been reached the flow will cease. Deteriorating visibility in the operating field then requires intermittent emptying of the bladder, achieved by removing the electrotome and draining fluid out through the resectoscope sheath with a concomitant evacuation of resection debris. Resection is thus intermittently and briefly interrupted throughout the entire operation.

On the other hand, low pressure irrigation allows continuous drainage of the bladder, i.e., irrigating fluid escapes either by an additional outflow channel in the resectoscope or through a trocar placed suprapubically before the operation (Bergmann 1971; Iglesias and Stams 1975; Truss 1968). Continuous drainage thus allows continuous resection. Intravesical pressure shows no significant increase during the normal progress of low pressure irrigation. The development and introduction of low pressure irrigation represented an attempt to reduce the entry of irrigating fluid into the open vascular system of the prostatic bed, since high intravesical pressures and the use of hypotonic electrolyte-free irrigation solutions had occasionally been described as giving rise to significant irrigating fluid infusion with subsequent so-called TUR syndrome (Beirne et al. 1964; Ceccarelli and Mantell 1961; Griffin et al. 1955; Hagstrom 1955; Madsen and Naber 1973; Maluf et al. 1956; Naber et al. 1973). The socalled TUR syndrome corresponds to water intoxication or the so-called disequilibration syndrome seen during dialysis. The underlying abnormality is always a dilutional hyponatremia with concurrent hypervolemia. The fact that low pressure irrigation may indeed markedly reduce the incidence of this complication has led to its achieving a certain degree of popularity (Baumbusch 1977; Büttger 1977; Faul 1977; Geister 1977; Hahn 1977; Iglesias and Stams 1977; Iversen and Iversen Hansen 1977; Oberneder 1977; Perez Castro 1977; Potempa 1977; Sparwasser 1977). Other advantages claimed for low pressure irrigation include improved visibility due to substantially continuous irrigating flow, shorter operating time due to the absence of periodic interruption and reduced blood loss due to improved hemostasis (Sinagowitz and Reuter 1978).

Sinagowitz and Reuter (1978) claim as a further advantage that it is easier for beginners to learn the technique on the grounds that continuous supervision is more easily achieved. Reuter (1980) describes tissue damage and extravasation, bladder atony, overdistension of the prostatic fossa, water logging of tissue, perforation, tissue separation and localized deposits or irrigating fluid as addi-

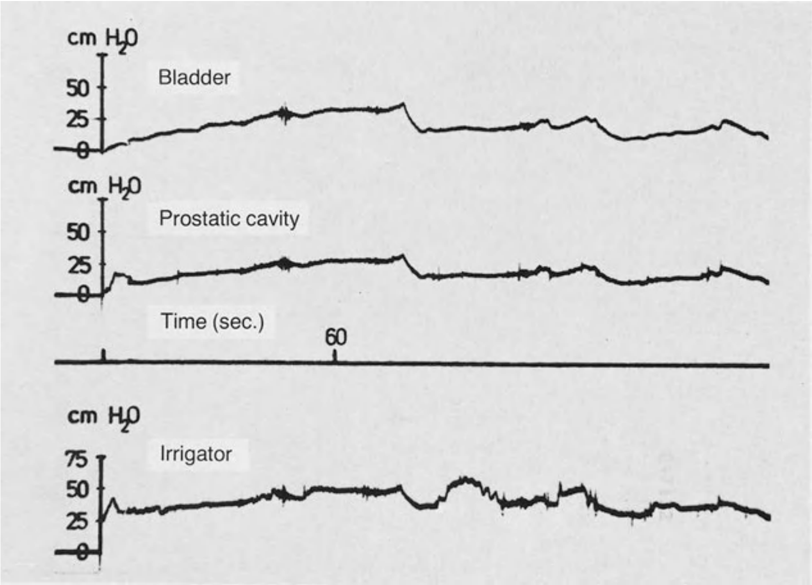


Fig. 106. Pressure curve for continuous low pressure irrigation using the irrigating resectoscope. Maximum pressures in bladder and prostatic cavity during continuous resection remain below 35 cm H_2O. As a result of this continuous irrigating technique and the pressure drop inherent in the tubing system, irrigating pressure measured at the inlet port of the instrument never equals the hydrostatic pressure head corresponding to the level of the irrigator (60 cm H_2O)

tional sources of complication following high pressure irrigation said to employ pressure heads not more than 50 cm of water.

Despite the at least in part indisputable advantages of low pressure irrigation, if is of course true that the high pressure technique has its own specific advantages which are extensively described elsewhere in this text. The following discussion is concerned with the fundamental physical differences between the two methods, with particular attention paid to avoiding the entry of large quantities of irrigating fluid into the circulation.

The pressure due to the inflow of irrigating fluid into the bladder consists of two components: hydrostatic and hydrodynamic. Measurements of hydrodynamic pressure with a variety of resectoscopes under conditions of both high and low pressure irrigation revealed that for an irrigator level of between 50 and 100 cm of water the *hydrodynamic pressure* never exceeded 5 cm H_2O (Reuter 1980; Schütz 1979; Sinagowitz and Reuter 1978). Hydrodynamic pressure is further related to the lumen of the irrigating channel and the viscosity of the irrigating fluid. Since the pressure in the prostatic veins can be assumed to lie in the region of 10 cm H_2O, hydrodynamic pressure of maximally 5 cm H_2O cannot be considered a significant cause of irrigating fluid infusion.

Depending on the irrigator level, however, high pressure irrigation may lead to the development of considerably greater intravesical hydrostatic pressure capable of giving rise to considerable delivery of irrigating fluid into both the

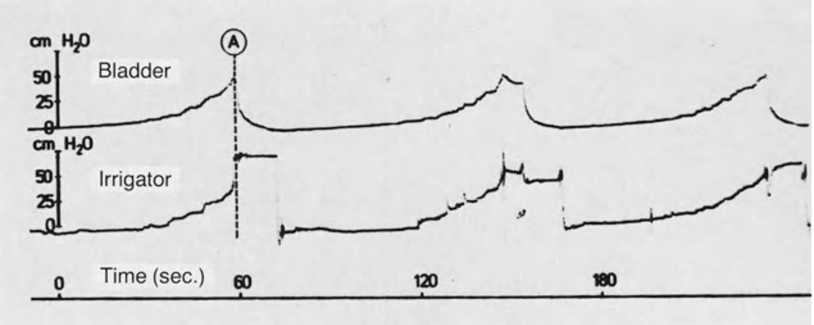


Fig. 107. Bladder and irrigation pressures for intermittent high pressure irrigation (irrigator head 60 cm). Each resection run is characterized by a gradual rise in intravesical pressure and its subsequent fall when the bladder is emptied through the sheath. The duration of each run is determined by bladder volume and rate of irrigating flow. At the time the bladder is emptied (A) through the sheath, intravesical pressure has risen to 45 cm H_2O. For a few seconds it thus lies above the limiting value for substantial irrigating fluid infusion. At the beginning of each emptying phase the full hydrostatic pressure of the irrigating fluid is seen since flow into the bladder is temporarily interrupted. This pressure corresponds to the irrigator level of 60 cm. It should be noted, however, that intravesical pressure at no time equals the irrigator hydrostatic pressure head. Since the increasing hydrostatic intravesical pressure tends to reduce the hydrodynamic pressure of the irrigating jet, deteriorating visibility inevitably leads to cessation of resection and drainage of the bladder before pressure equilibrium occurs

intravascular and extravascular spaces. For this reason a limiting irrigation pressure of less than 60–80 cm H_2O has been prescribed for high pressure irrigation (BAUMRUCKER 1968; BRÜHL and SAUERWEIN 1977; CASTRO 1974; MAUERMAYER 1962; NABER et al. 1973). It would appear that significant irrigation fluid infusion does not occur if a critical hydrostatic intravesical pressure of 32–48 cm H_2O is only briefly exceeded during resection.

Low pressure irrigating systems avoid the occurrence of high intravesical hydrostatic pressure levels, since automatic drainage of the bladder contents occurs every time a predetermined intravesical pressure is exceeded. A typical pressure time curve measured during low pressure irrigation is presented in Fig. 106. It may be seen from Fig. 107 that high pressure irrigation may not in fact give rise to substantially higher pressures than the low pressure irrigation. It should be noted that there is never complete equilibrium between intravesical and irrigator pressures.

High and low pressure irrigation are both techniques available for electroresection of the prostate. The risk of infusion irrigating fluid during low pressure irrigation would appear prima facie to be less. On the other hand, limiting the irrigator level to 60 cm and avoiding equilibrium between intravesical and hydrostatic irrigator pressures during high pressure irrigation would seem substantially to eliminate the risk of irrigating fluid infusion and consequent TUR syndrome. Since this is so, the significant advantages discussed in the individual passages on various aspects of resection weigh strongly in favor of adhering to the high pressure irrigation to which they are specific.

h) Special Devices for Evacuation of Resection Chips

α) Preliminary Considerations. The above-described methods ensure the evacuation from the bladder of virtually all resection debris together with the irrigating fluid, a sole exception being resectoscopes with continuous evacuation or trocar evacuation. There remain, however, certain anatomical situations (deep prostatic recess) in which a few chips will nevertheless remain in the bladder. The technique of resection itself may, furthermore, influence the number of chips left in the bladder base at the end of the operation. Particularly if the resectoscope sheath is not held in the fashion I have previously described so as to execute sweeping motions across the bladder base, numerous fragments are likely to remain in the bladder. If the bladder is thus not completely clear of resection debris it is necessary to attach an evacuator to the sheath and remove the remaining tissue fragments in this fashion. The fundamental problems of evacuation are however, the same for all systems and they are therefore discussed at the outset.

The evacuation process requires a certain quantity of fluid which will be shifted back and forth. Therefore the bladder should not be completely emptied prior to evacuation. Furthermore, the resectoscope sheath must be held in such a fashion that its aperture is not able to suck in bladder mucosa (Fig. 108), and this may be achieved in a more or less horizontal position. A different situation arises in the presence of a deep retroprostatic recess. In such cases the sheath must be inclined down toward the bladder base. It is perhaps best to use a gentle irrigating flow to first inspect the bladder base and direct the sheath aperture towards the area containing the most chips. The sheath is then held firmly in this position, the electrotome removed, and the chips subsequently evacuated. The presence of numerous pseudodiverticula may render evacuation particularly difficult. It may then be necessary to use the loop to draw individual

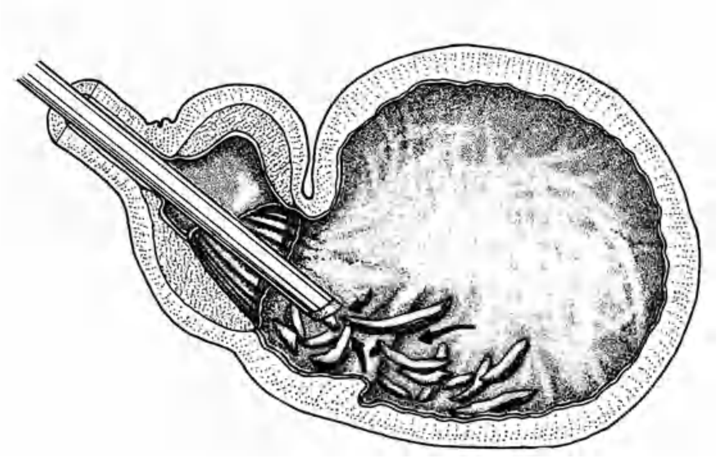


Fig. 108. Diagrammatic sagittal section through bladder and prostatic capsule. The end of the instrument is directed toward the bladder base but is not closely applied to it. This position may be achieved prior to evacuation under visual control. Sudden interruption of evacuation indicates that the sheath aperture is lying against the base of the bladder

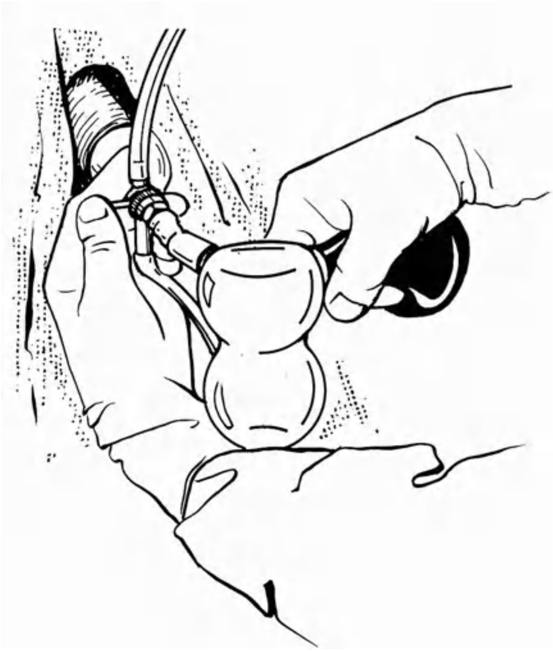


Fig. 109. Evacuating resection material with the Ellik evacuator. The evacuator is attached to the opening of the resectoscope sheath by a conical connector. Our resectoscope, with its central stopcock, obviates the need for prior filling of the evacuator. Air entering the bladder during the filling process is easily vented through the central cock by elevating the end of the sheath into the vault of the bladder and setting the stopcock to the drain position. The Ellik evacuator should be operated with small pumping excursions only, since this provides the most rapid evacuation of fragments (see also removal of calculous material following litholapaxy

chips into the sheath and thus extract them by removing the electrotome. At the end of the operation the bladder should be subjected to a further thorough examination to ensure that all resection chips have been removed. For this purpose the water flow should be reduced to the minimum so that any remaining fragments will lie in the base of the bladder rather than being stirred up. Evacuation at the end of the operation should also always be followed by a further examination of the wound cavity, since forceful fluid shifts may occasionally reopen vessels which had previously been closed.

β) Use of the Ellik Evacuator. This is the technique most frequently employed in the Anglo-Saxon world, but it has only recently gained popularity in German-speaking countries (Fig. 109). The method requires an additional sterile bowl of irrigating fluid in which the evacuators are held at the ready, thus avoiding the laborious business of discharging air once they are attached to the instrument. It is true that sheaths with a central cock facilitate the filling of evacuators, but it nevertheless remains an additional maneuver. Care should be taken that the rubber bulb is also free of air so as to obtain a maximum suction effect.

The device is attached to the resectoscope sheath by means of a suitable cone joint. Some models are designed to lock onto the sheath. Evacuation

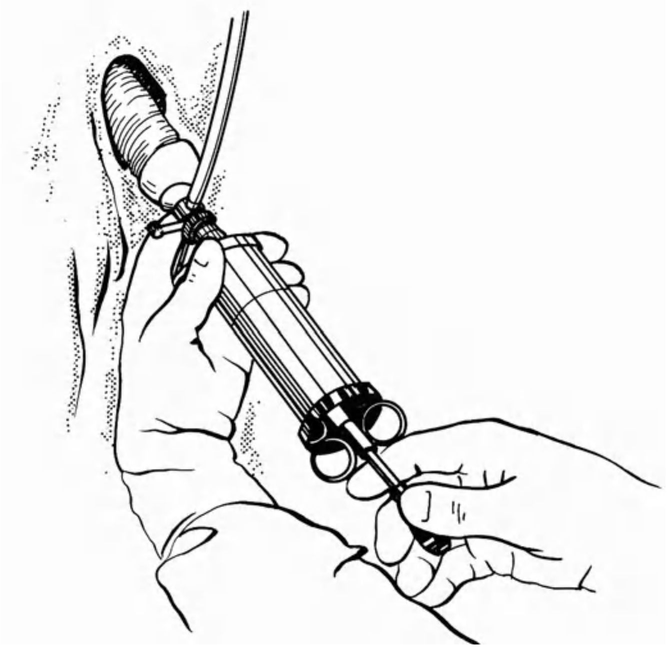


Fig. 110. Evacuating resection material with the piston syringe. An advantage of the metal piston syringe is its ability to be connected to the sheath in a rigid and airtight fashion. It is simply pushed into the sheath opening and locked by turning it to the right. A rigid sheath-syringe unit is capable of not only aspirating large tough fragments but is also ideal for evacuating coagula of any size

is best achieved by a gently oscillating pump action at the bulb, the amplitude being so adjusted that water is aspirated out of the bladder into the upper half of the Ellik evacuator. The flow of water is here diverted in a circular direction with the final result that resection chips (or calculous fragments) sink to the bottom of the glass vessel. Experience has shown that gentle movements are more effective than violent ones, since the latter may suck bladder wall into the sheath aperture. Evacuators should be changed frequently to avoid washing tissue fragments back into the bladder. A bowl in which two on three *filled* evacuators are kept in reserve is thus of considerable help and saves operating time.

In the presence of a large number of resection chips, blockage of the sheath lumen and/or cone adaptor of the evacuator may rarely occur. This is an inherent limitation of the technique and may equally manifest itself during attempts to evacuate consolidated clots from the bladder.

In such cases, the use of a metal pistoned syringe is considerably more effective and has no true substitute.

γ) Evacuation by Metal Piston Syringe. This method of removing resection material (see Fig. 110) has been our practice for many years, and in our opinion, as well as that of many other users of the technique, offers a variety of advantages over the rubber bulb:

1. The syringe may be laid out on the instrument table without a requirement for prior charging.
2. The syringe may be filled by simply connecting it to the resectoscope sheath and running in irrigating fluid.
3. Sheath and syringe form a rigid unit facilitating coordinated movements of the two.
4. Large fragments may be extracted because of the powerful suction generated by the syringe piston. This is also true for blood clots, which may become extremely hard and tenacious if left in the bladder for any length of time.
5. The metal piston syringe has a stroke volume of 150 ml. This allows large amounts of fluid to be shifted with a consequent powerful suction effect. The few remaining fragments that so often lie hidden within pseudodiverticula are thus more likely to be extracted.
6. Being independent of the recoil of a rubber bulb, the suction generated by the syringe may be finely adjusted.

This description of its advantages should be enough to recommend the use of the syringe. Naturally, special care is required when manipulating any rigid system within the bladder and forceful movements could theoretically bring about a bladder injury. The fact that we have not seen a single such injury among the over 9000 resections we have performed since 1952 will give some idea of the practical significance of this risk.

There is of course an absolute requirement for careful maintenance of the syringe. If, for example, poor cleaning technique leaves any fibrin residue on the inner surface of the glass barrel, the piston will not move with the ease required for proper functioning of the instrument. This point should therefore receive particular attention during instrument preparation.

Equally, syringes with excessive play between piston and cylinder should be repaired or replaced, since they develop inadequate suction.

δ) The Extraction of Outsize Tissue Fragments from the Bladder. Within this discussion of techniques for extracting and evacuating resection debris a particular type of tissue fragment deserves special mention, although it may only rarely cause problems. In my book published in 1962 I called this „das große, freie Stück“ (the large, free-floating fragment). The dimensions of these outsize pieces make them incapable of normal evacuation, and because of their tendency to suddenly and repeatedly interrupt drainage, they usually draw attention to themselves during operation. They are likely to occur whenever an adenoma with large endovesical moieties is operated on. If the waist of such a large median or lateral lobe is cut across, part of the lobe falls into the bladder base and tends to lie across the sheath aperture like a flap valve.

The technique of cutting up these large lumps is not particularly difficult if certain maneuvers are practiced.

1. First of all one must obtain a good view of the fragment. It will be carried around the bladder by the irrigating flow and is most easily found by empty-

ing the bladder through the central cock under direct vision and waiting until the fragment sinks to the bottom.

2. With its loop extended the instrument is now carefully advanced towards the fragment, the sheath aperture presses it firmly against the bladder base and small "nibbling" cuts are executed to divide it into evacuable segments. Firm pressure against the bladder is required in order to close the circuit for the cutting current.
3. If control is lost of the main fragment during this procedure, it must again be approached as described under point 1 above. Finally, care should be taken when the fragment is nearly completely cut up so as to avoid injury to the bladder base.
4. At this stage it may be of assistance to firmly jam the fragment between loop and sheath aperture and thus withdraw the instrument and fragment in one. The soft piece of tissue will mould so easily to the urethral lumen as not to be dragged out of the loop.

Note: Although I initially experienced many such incidents, the occurrence of "large, free-floating fragment" has become a rarity using the techniques to be described.

IV. Cutting Technique

1. The Cut Proper

Cutting with the resectoscope loop is a technically simple process. The tissue to be divided is brought to lie between cutting loop and sheath aperture, following which current is applied and the cutting loop withdrawn into the sheath (Fig. 111). There are a variety of technical variations on this simple process, and these are now to be discussed.

a) The Cut with Predetermined End Point

In this technique the resectoscope sheath (sheath aperture) remains fixed at the point determined as the end of the cut (Fig. 112). This arises particularly when operating near the external sphincter for the removal of apical tissue or of a nodule extending toward the sphincter. The sheath aperture covers the area of the operating field to be protected (Step 1). The loop is then extended over the tissue to be removed (Step 2). Finally, current is applied and the loop withdrawn into the sheath, thus removing the previously selected tissue (Step 3).

The *advantage* of this method is protection of endangered tissue by the resectoscope sheath.

One *disadvantage* for the beginner may lie in the invisibility of the starting point beyond the obstacle. The loop may be allowed to sink too deeply into the tissue, since the cut starts "blind."

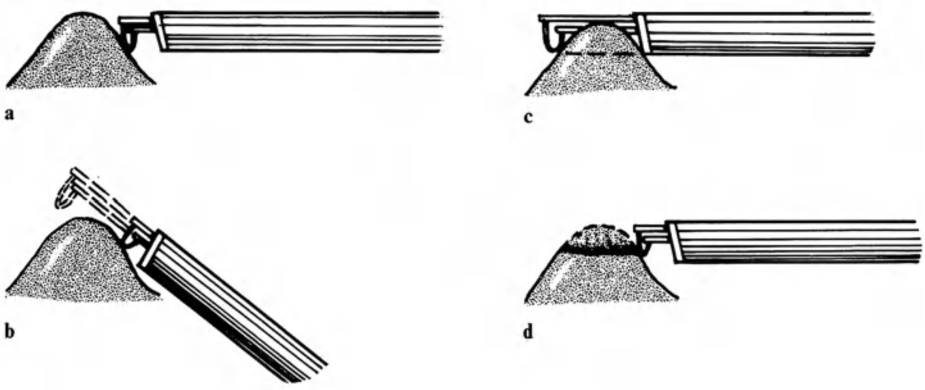


Fig. 111 a–d. Diagrammatic representation of the cutting process. The obstacle (e.g., median lobe of the prostate) is observed with the instrument (**a**). The next maneuver is to lower the eyepiece so as to negotiate the loop over the obstacle (**b**). After returning the sheath to its original position (raising the eyepiece) the obstacle is brought to lie between sheath aperture and cutting loop (**c**). If cutting current is now applied and the loop withdrawn into the sheath the intervening tissue will be transected (**d**)

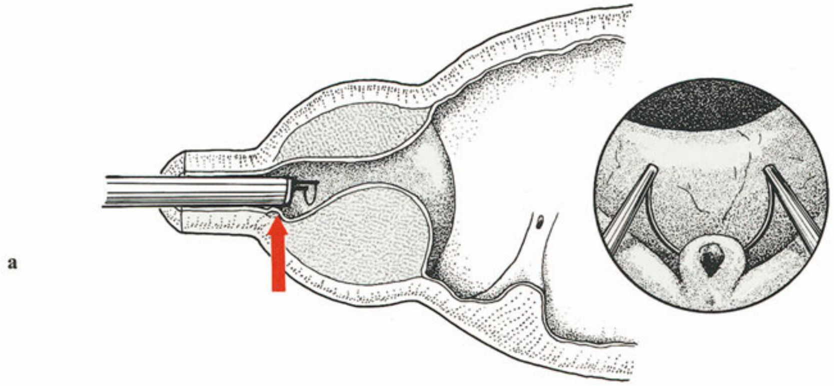
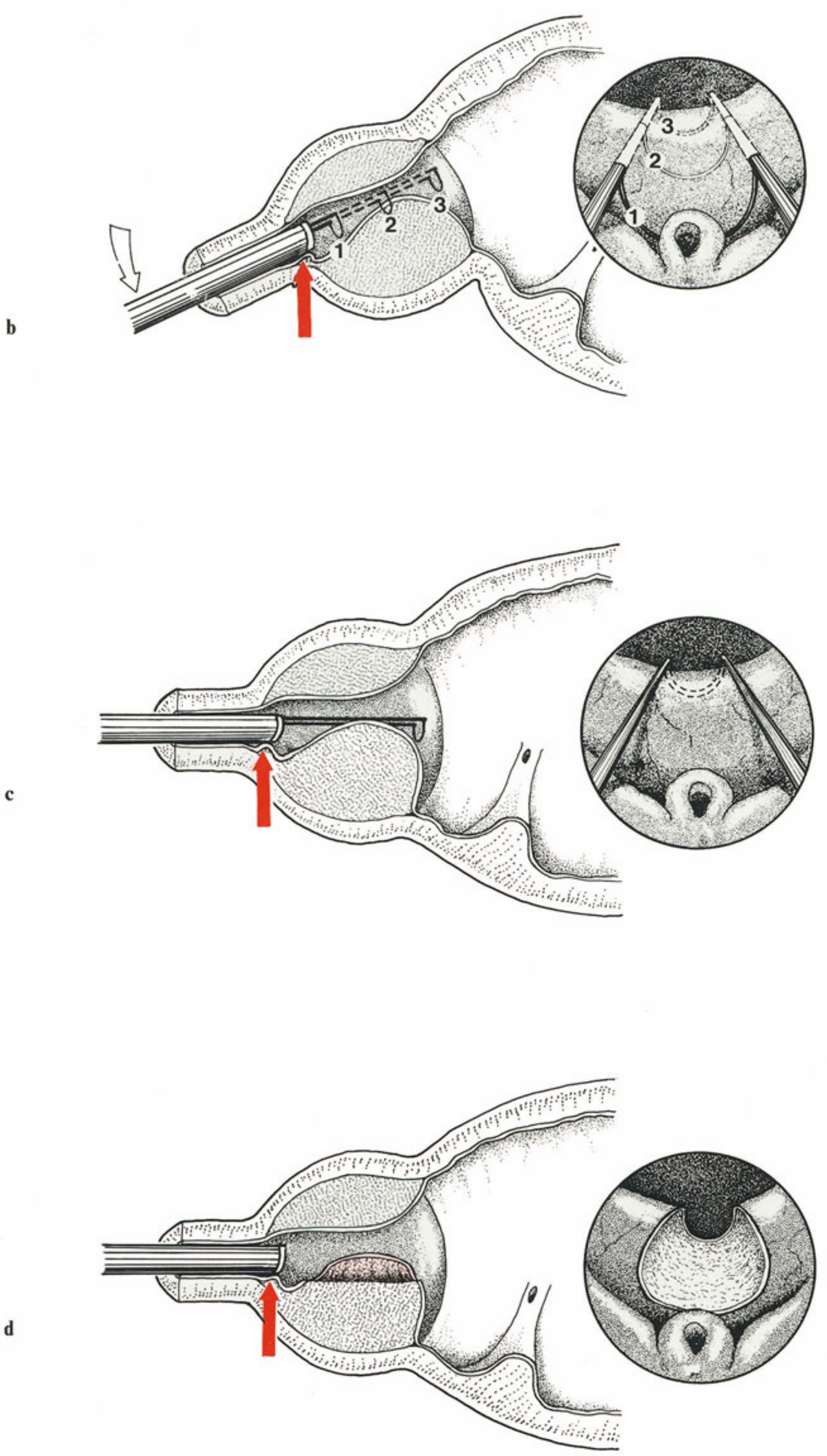


Fig. 112 a–d. Cutting with predetermined end point. **a** The sheath aperture lies at the level of the verumontanum. In the right-hand drawing the verumontanum is shown in order to illustrate the situation, but will be covered by a short advancement of the sheath prior to cutting. It is thus safely protected. The *arrow* in the left-hand half of the figure is to indicate that the sheath aperture is held stationary in this protective position. **b** The eyepiece of the instrument is lowered and the cutting loop advanced into the bladder over the obstacle. Individual stages in this process are numbered *1–3*. **c** The eyepiece is now raised to press the tissues more firmly against the loop which spans it, thus producing a deeper cut. The sheath aperture is held immobile in the plane of the verumontanum (see also Fig. 111). **d** Retraction of the cutting loop into the sheath. A groove is thus cut in the tissue. For demonstration purposes, the verumontanum has been represented in these illustrations as though it were in front of the end of the sheath. In reality it lies beneath the sheath and is thus well protected


b
1
2
3
3
2
1
c
d

Illustrations 19–23 (Plate IV) illustrate this process. Illustration 33 (Plate VI) is particularly instructive in relation to this cutting technique as applied to a small adenoma. Note that a median groove has been cut in the 6 o'clock position and that the verumontanum may be distinguished at the distal margin. In this case the loop is engaged under vision at the proximal dividing line between adenoma tissue and capsule. The loop is held steady at this point and the sheath gradually retracted until the verumontanum just appears in the field. The latter is then covered by the sheath aperture so as to be guarded against injury during the subsequent cut.

b) The Cut with Predetermined Starting Point

This cutting technique should be applied when a danger area (e.g., ureteric orifice or interureteric bar) lies close to the starting point of the loop. The cutting process is then the exact opposite of that previously described (Fig. 113). The loop is applied to the desired point at a safe distance from the area to be protected. When extending the loop, the resectoscope sheath is gradually withdrawn down the urethra toward the verumontanum so as to hold the loop in a fixed position. Cutting is once again achieved by then withdrawing the loop into the sheath aperture.

The *advantage* of this technique is the clear visualization of the area to be protected in the vicinity of the starting point. This is an important requirement when operating on median lobes closely related to the ureteric orifice or interureteric bar, and the technique may also be invaluable in the removal of papillomas in the same region. This description of the process may sound complicated, but a practiced operator will apply it automatically without conscious awareness of the individual steps.

A *disadvantage* may occasionally arise from invisibility of the end point.

The two cutting methods thus described blend imperceptibly with one another. They represent the basic elements of tissue separation.

c) The Extended Cut

In the previously described cutting technique, length of cut is determined by the limited range to which the loop may be extended from the sheath. This

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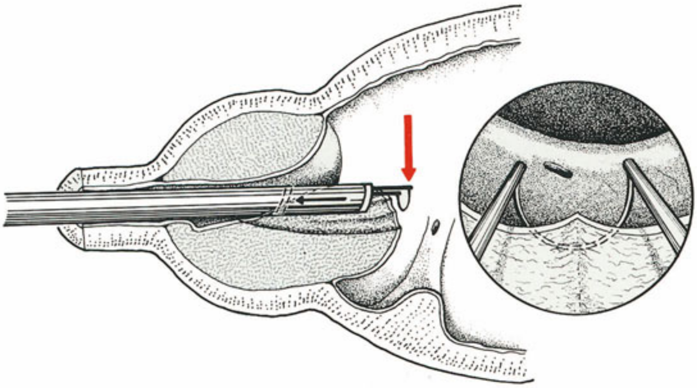
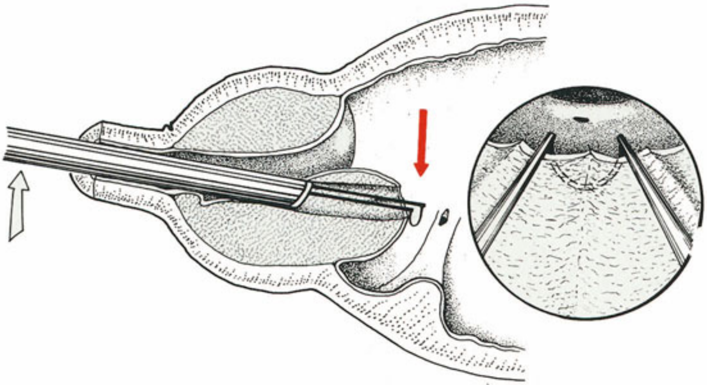
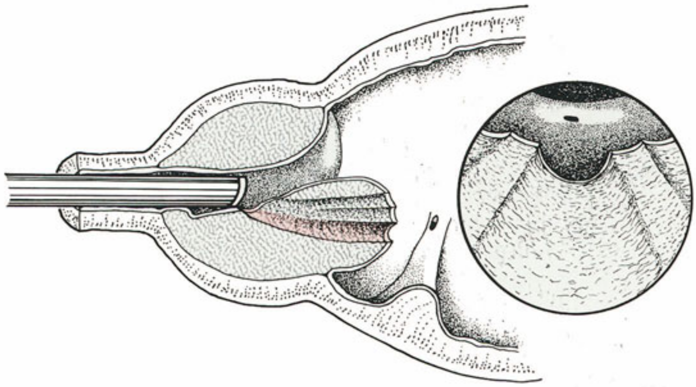
Fig. 113a–c. Cutting with predetermined starting point. The resection of a median lobe protruding ▷ into the bladder is shown. The adenoma reaches the vicinity of the interureteric ridge and ureteric orifices, which must therefore be protected from inadvertent injury. To this end the loop is applied to the tissues under visual control. **a** The cutting loop is only slightly extended out of the sheath and placed behind the tissue to be removed where it is engaged as deeply as possible. **b** The loop is kept firmly fixed in this position but the sheath is gradually withdrawn distally to the planned extent of the cut. **c** The process is concluded by applying cutting current and withdrawing the loop into the sheath



a



b



c

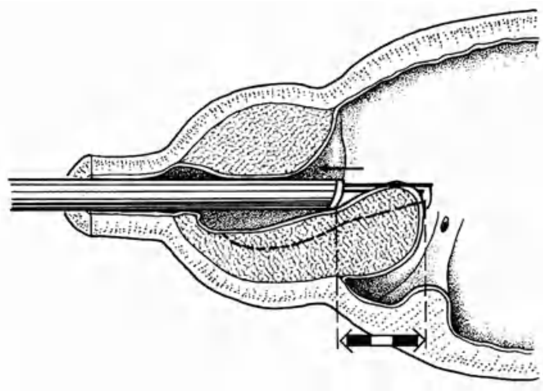
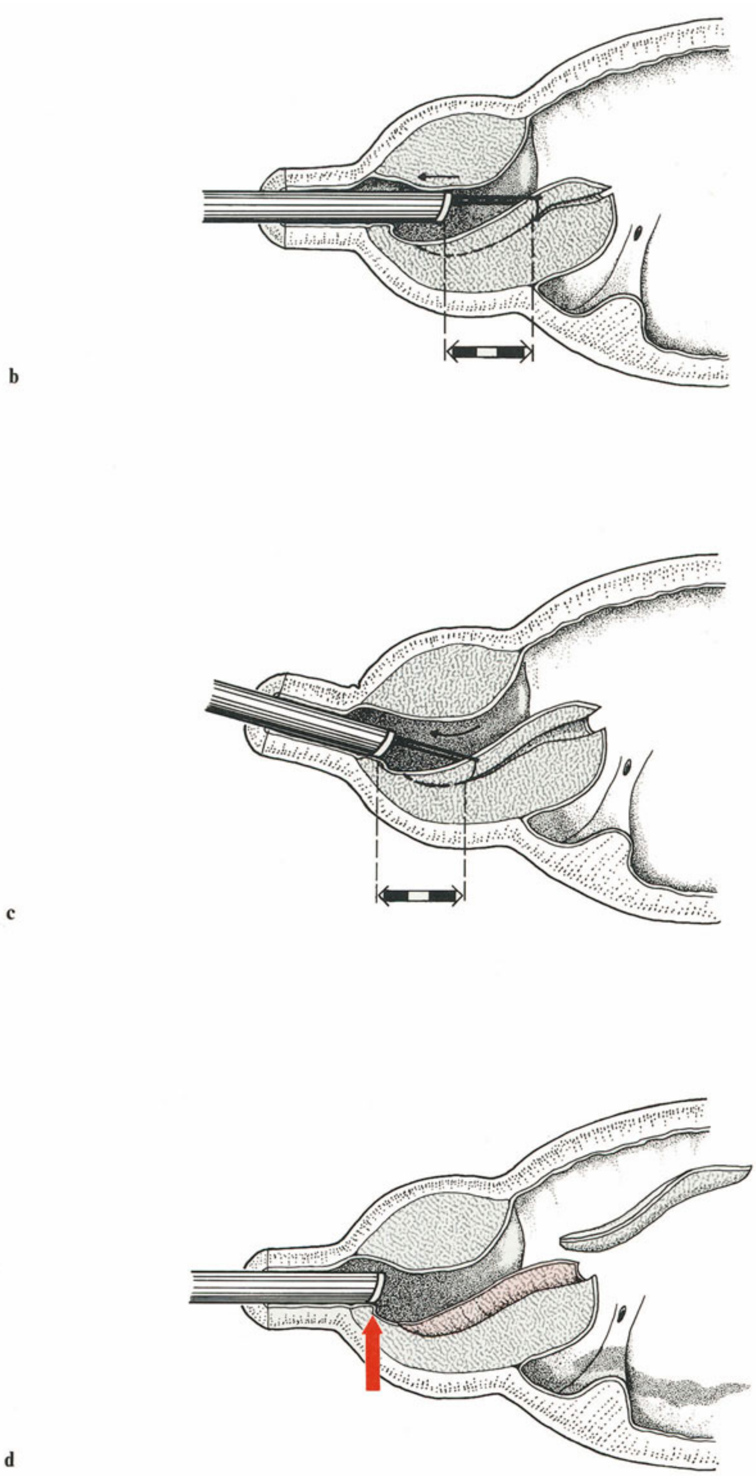


Fig. 114a–d. The extended cut. This type of cut is used whenever long tissue elements are to be removed (e.g., long median or lateral lobes or a large bladder tumor). This is the most efficient cutting method because of the large amounts of tissue which may be removed in a short time. The extended cut technique is also suitable for the final phase of resection when the wound cavity is to be smoothed. **a** The cutting loop is engaged either blind (corresponding to the predetermined end point technique) or under direct vision (predetermined starting point). The tissue surface and part of the cutting loop lie within the field of view. **b** The entire instrument, that is the cutting loop together with the sheath, is now retracted. During this process the loop is kept in a fixed position, somewhat protruding from the sheath. Tissue is seen sliding past the telescope. **c** The process is continued until the end point of the cut appears in the field of view (in this case the verumontanum). This indicates the margin of intended resection. The sheath is slightly raised and brought to rest, the aperture covers the verumontanum, and the cutting loop is withdrawn into the sheath. This concludes the cut. **d** This illustration shows the state of affairs at the end of the cut, the resection groove shown in red. The sheath aperture has masked the verumontanum and the loop is "parked" within the sheath

distance varies with the exact design of the instrument between 2 and 3 cm. When operating on larger adenomas there may be an unavoidable requirement for somewhat longer cuts, and if these are intended the following technique may be applied (Fig. 114).

The loop is applied at the desired starting point under direct vision but is kept fully extended from the sheath. Cutting is now achieved by withdrawing the entire sheath distally and the required end point appears within the field of view. Movement of the resectoscope sheath now ceases and the cut is concluded by retracting the loop into the sheath in the usual fashion. This enables the execution of cuts up to a length of several centimeters, depending on the length of the bladder neck. The beginner may find this extended cutting technique difficult, since he will be uncertain how far distally he may cut.

This difficulty in recognizing the proper end point may be solved by dividing the line of the first cut into a number of individual stages until the desired end point is reached by standard technique (Fig. 115). The end point may be recognized, e.g., by the proximity of the verumontanum or by the curvature of the lateral lobes. Once the end point has been defined by this subdivided cutting technique, further extended cuts in the vicinity are easily orientated with reference to the first cut. At the start of resection the prostatic urethra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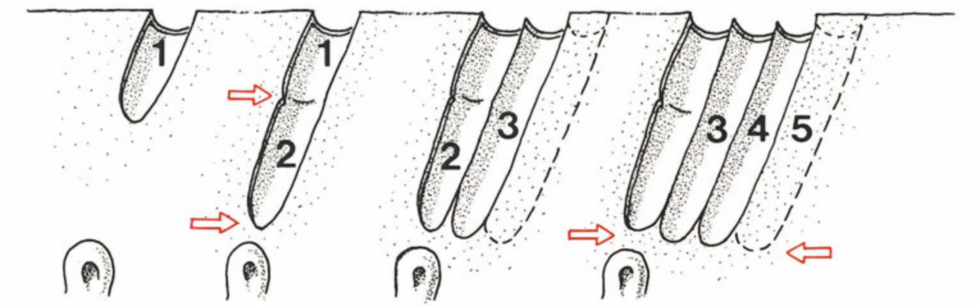


Fig. 115. Determining the end point of a cutting series and the divided cut technique. This cutting technique is based on the fact that only a short distance may be properly visualized by the resectoscope. The cut is therefore subdivided into individual portions small enough to present no difficulty of orientation. The loop is reapplied at the end point of cut (*1*) employing the technique of predetermined end point. The verumontanum remains masked by the sheath. The loop is applied to the end point of the first cut and withdrawn into the sheath. The result is a composite groove of the required length (*2*). For adjacent grooves the technique of extended cut is employed, the end point being the end of the previous composite cut. The rest of the procedure is easily read from the diagram

is invested with mucosa, so that the first cutting series will create a shallow groove devoid of epithelium and exposing naked adenoma tissue. The next cut is so placed as to keep the margin of the previous one within view. When the end point of the previous cut appears in the field (recognizable by the reappearance of mucosa), the end point of the second cut will be defined. As when ploughing a field, the end point of each furrow is placed adjacent to that of the previous one. The same approach can be employed when removing the second layer, since the mucosal edge remaining from the previous cutting series may be used as a landmark (Fig. 116). This extended cutting method may of course equally be employed in conjunction with the Nesbit technique of first cutting out the groove that separates adenoma from capsule. Once again, cutting ceases as the mucosal edge appears within the field.

Other landmarks for extended cutting are tissue differentiation and the configuration of the adenoma. This means that the experienced surgeon will end his cut when he finds himself leaving adenoma tissue, or when the curvature of the nodule reminds him that he is coming to the margin of the adenoma.

Extended cutting is excellent when used like a jack plane to smooth the surface of the resection cavity. The cut is kept shallow so as to remove only a thin layer and obliterate unevenness.

Advantages of the method are the rapid removal of large quantities of tissue and the creation of a smooth-edged cavity. Accidental injury is virtually impossible as long as the above maneuvers are carefully observed and the surgeon gradually improves his technique, rather than attempting, at the outset of his training, to emulate the rapid cutting sequence of his experienced colleagues.

The only *disadvantage* is the difficulty in mastering the method.

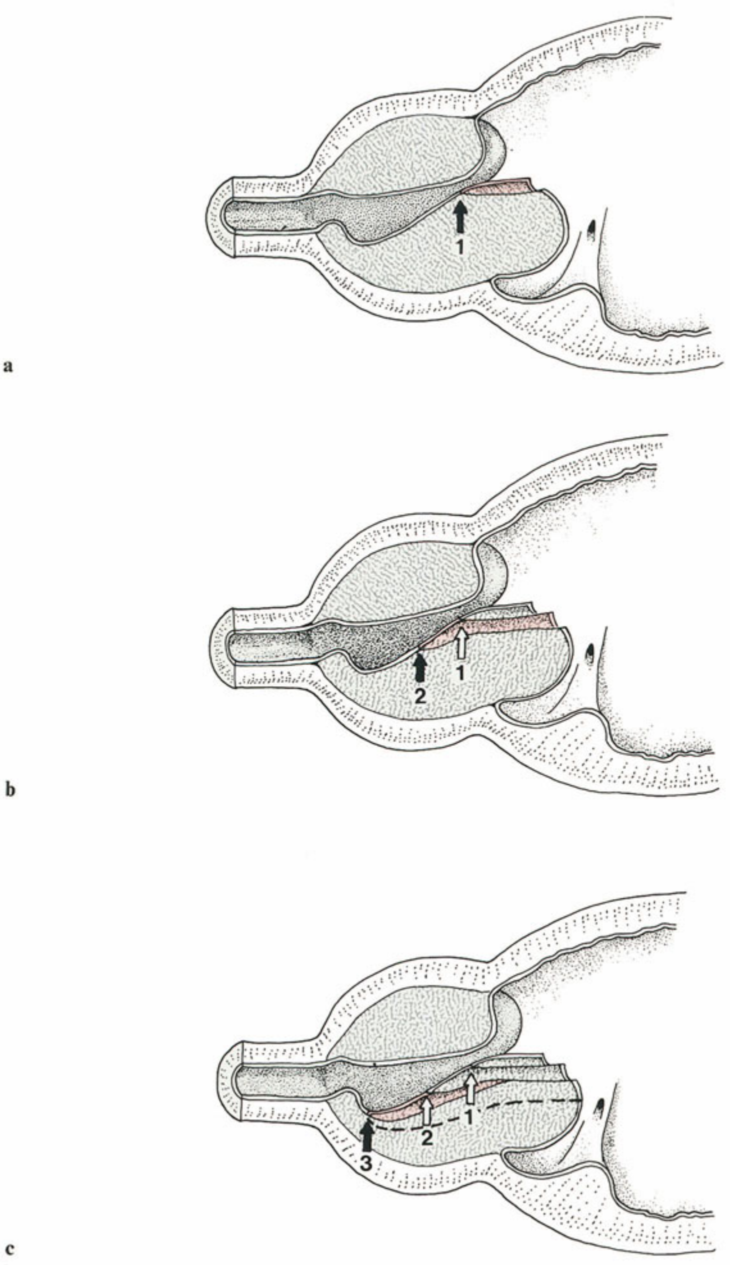


Fig. 116a–c. Divided cut technique, a practical example. **a** The first cut is executed according to the predetermined starting point technique (corresponding to groove *1* in Fig. 115). **b** Extension of this cut toward the verumontanum. **c** The last cut is once again executed with predetermined end point. The verumontanum remains masked by the sheath aperture (*3*). All further cuts are then terminated in relation to this point (*3*). A similar procedure is adopted for bladder tumors, where it may, e.g., be necessary to cut down toward a ureteric orifice. There is no methodological difference

d) Retrograde Cutting

Reverse cutting may be achieved by extending the loop out of the sheath and carving off tissue as with a woodcarver's gouge (Fig. 117). This method is *not* without danger since, in contradistinction to all other resection techniques, cutting is not terminated by the loop coming to rest in the retracted position, and the cut will continue as long as current is applied and the loop is in contact with tissue. Furthermore, the cut progresses away from the viewing system, and the end point is therefore not always accurately seen. I would therefore only recommend retrograde cutting for the effacement of small irregularities which cannot otherwise be removed. Some find it easier to remove residual tissue in the region of the verumontanum by cutting toward the bladder in this fashion. Although I know from conversation with colleagues that some prefer this technique, we restrict its use to minor smoothing maneuvers, since the hazards mentioned above are particularly severe for the beginner. There is a single true indication where reverse cutting leads to rapid success: division of an iris-like internal meatal stenosis. The exact sequence of this procedure is described in Chap L, V. (See p. 390.) Briefly, the extended loop is used to clear a way for loop and sheath alike out of the prostatic cavity and through the obstacle. A single cut is usually adequate to allow the instrument through into the bladder, so that the operation may then proceed in the usual fashion (see Plate V, Illustrations 26 and 27).

The *advantage* is the absolute definition of the starting point.

The *disadvantage* is the unreliability in determining the end of the cut.

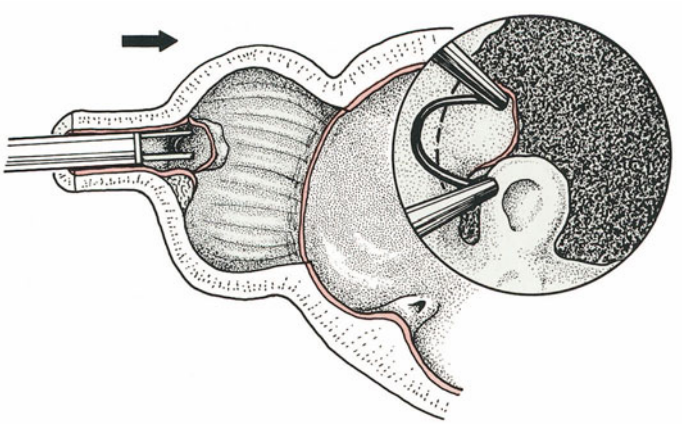


Fig. 117. Retrograde cutting. In this technique the cutting loop moves away from the instrument but does not attain its limit of travel at the end of the cut. This type of cut is therefore only suitable for certain special cases, since the risks are not entirely predictable (perforation, penetration of the loop to an undesired depth). In the example shown here the loop is cutting a small tissue protuberance off the paracollicular region in a retrograde fashion. In this region there is no danger attached since the procedure is a minor rectification. Length and depth of cut are under direct control. The cut is usually executed with loop and sheath together. The extended loop protrudes somewhat from the sheath, and a common movement allows the fixed energized loop to push the tissue away

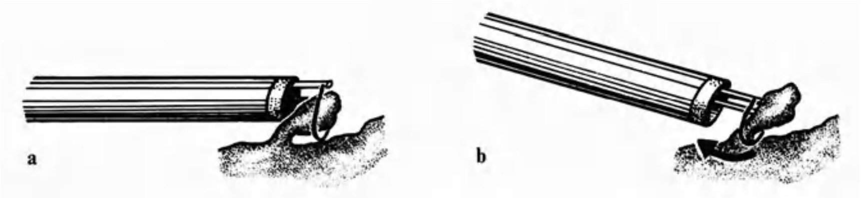


Fig. 118a, b. Entrapment cutting. This technique employs a combination of mechanical and electrical tissue separation. It is suitable for use wherever a small tag of precoagulated tissue is to be removed. The loop often cuts poorly under these circumstances and wedging of the tissue between the loop and sheath aperture improves the electrical contact as well as imparting a mechanical component to the cutting process. The loop is used to press the tissue against the sheath aperture (**a**) and as the cutting current is applied a levering movement separates the tissue (**b**)

e) Entrapment Cutting

This variation is employed when small irregularities prove difficult to remove during final cleaning out of the resection cavity at the end of the operation. Problems often arise when previous cuts have precoagulated the tissue. In such a case a solution is readily found if the tissue fragment is caught between cutting loop and sheath aperture (entrapment cut) and then separated by applying current (Fig. 118). Such firm fixation of the fragment between loop and sheath ensures a particularly good circuit for the cutting current. Retraction of the sheath then allows complete separation.

2. Practical Aspects of Resection

The individual types of cut described above merge so smoothly during their practical application in surgery that an observer watching the procedure through a teaching attachment or on a video screen frequently has difficulty in discerning individual techniques, unless they are specifically pointed out.

The aim of all these considerations remains that of *always* maintaining a well-defined resection cavity allowing correct orientation and careful hemostasis during every phase of the operation.

This is achieved by a systematic working procedure, as described below.

a) The Single Cut

In the early years this was the standard technique of resection. A tissue fragment was separated with the loop and then withdrawn from the sheath together with the electrotome, a technique largely dictated by the parameters of the cutting current employed. A very considerable coagulating effect led to rapid encrustation of the cutting loop. Fragments therefore frequently adhered to the loop, and the electrotome had to be withdrawn from the sheath and tissue picked off the loop to maintain adequate visibility. Such single cuts are nowadays only employed if a piece of tissue is to be removed from a certain area for a specific purpose, e.g., histologic examination. The precise cutting action of modern diathermy current frequently leads to the tissue fragment completely separating and being washed into the bladder, whence it must subsequently be evacuated. This effect can only be avoided by interrupting the irrigating flow shortly before the end of the cut. The technique is equally useful for making small corrections at the end of the procedure. In order to avoid repeating the evacuation of resection chips from the bladder, a number of single cuts are executed in the manner described (i.e., interrupting irrigation at the end of the cut). Lastly, a marked reduction in bladder capacity may dictate the use of this technique.

b) Serial Cutting

Most work is nowadays done in this fashion. Portions of tissue are separated in a rapid sequence of cuts carefully placed side by side so as to achieve a defined field of resection. The same principle applies, albeit with a shallower depth of cut, once the main bulk of tissue has been removed and the operation moves into the phase of careful cleaning of the capsule.

There is a simple reason for preferring serial cutting: every time the electrotome is reintroduced, the irrigating system requires a short period of time to produce a clear field of view. The operation cannot proceed until reorientation is thus possible. The time available for actual tissue removal would thus be drastically less with single than with serial cutting. A normal capcity bladder and moderate irrigation flow will allow the serial removal of 20 or more chips before the bladder needs to be emptied.

On the other hand, serial cutting requires a certain degree of technical ability. The aim is to clear a reasonable area of resectable tissue in a rapid series of cuts, while maintaining an acceptable blood loss and without losing sight of the overall situation. This in turn demands a systematic approach, best understood by reference to a simple example: the removal of tissue is best compared with a ploughing of a rectangular field by the parallel placement of furrows; as shown (schematically) in Fig. 119.

There are various examples of the practical application of this technique, such as the ablation in layers of lateral and median lobes. Even the fairly difficult resection of apical tissue may proceed along such lines: a marking furrow is first ploughed and the remaining tissue then reduced to the level of this initial cut (see p. 203 for details).

Some mention should finally be made of the various depths of cut (Fig. 120).

The amount of tissue removed by an individual cut will depend on the depth of penetration of the loop. Early in resection, when a considerable amount of tissue remains to be removed, the loop may cut deeply into the tissue. The nearer one comes to the prostatic capsule the shallower the cuts should become, their depth being controlled by angulation of the sheath (raising or – for lateral tissue – contralateral abduction of the eyepiece), or by pressing tissue up toward the instrument. The latter technique can only be employed for dorsal tissue, where the capsule lies in contact with the rectum.

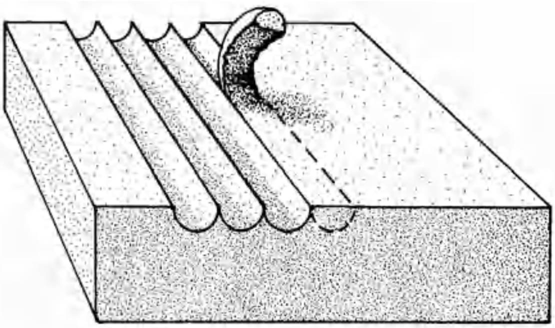


Fig. 119. Serial cutting. This diagrammatic and somewhat idealized illustration demonstrates the guiding principle of serial cutting: each cut is laid parallel to the previous one, a process readily comparable to the ploughing of a field. The result is a clearly defined operating field. Orientation problems are best solved in this fashion, since depth and end point of each successive cut are derived from the preceding cut

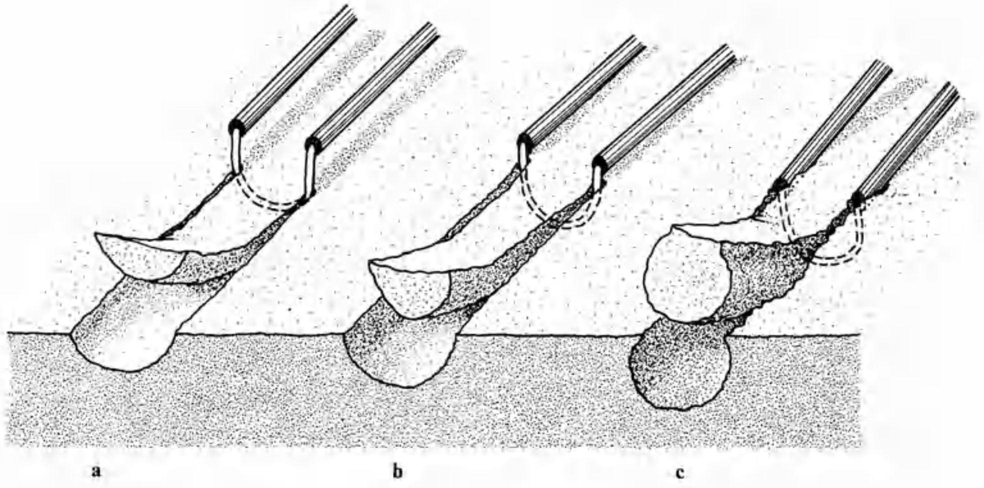


Fig. 120a–c. Varying depths of cut. Shallow (**a**), normal (**b**), and deep (**c**) cuts are shown in diagrammatic form. These three depths of cut may be employed according to the amount of tissue to be removed. **a** Close to the prostatic capsule or when excising a bladder tumor deep in the muscle a shallow cut should be employed. **b** This shows normal cutting. **c** The loop may be allowed to penetrate deeply into the tissue, e.g., when a marking trench is being cut out of a lateral lobe, that is when a very substantial layer of tissue is to be cut through or separated

In this region the loop may be allowed to penetrate so deeply that its insulated side arms themselves sink into the tissue. This allows the removal of tissue fragments of greater thickness than the radius of the loop (see Fig. 124c), although only the most experienced surgeon should attempt this.

Depth of cut is further determined by the size of the loop. Correspondingly larger resectoscopes (28 Ch and greater) will naturally allow the removal of more tissue per unit time than is possible with smaller instruments (24 Ch and less). The size of the loop is not, however, the be all and end all. Some years ago we adopted the practice of working exclusively with 24-Ch instruments so as to reduce mechanical trauma to the urethra to an absolute minimum. Despite this, resection times and weight of tissue resected per unit time have not decreased, probably because inurement to a single instrument outweighs purely mechanical factors.

c) Excavating the Capsule

This chapter aims at presenting *basic techniques* and we cannot therefore devote space to detailed methods of excavation. The following is, then, only a general review of the problems involved.

In a vivid simile, NESBIT compared excavation of the capsule with the cutting loop to spooning out the flesh of half an apple. To this day no better or more realistic description has been given of this operative procedure, and it is for this reason that the expression "teaspooning" has gained general acceptance in the Anglo-Saxon literature.

Anyone attempting a true transurethral adenomectomy must have fully mastered this technique. In Nesbit's simile the prostatic capsule surrounding the adenoma represents the skin of the apple, and the adenoma itself the flesh of the fruit. Any attempt to cut adenoma tissue out of the capsule must therefore take account of the spheroidal shape of the organ.

The cutting techniques described so far are all concerned with a straight linear cut executed while the sheath is held in an absolutely stationary position. If, however, the eyepiece of the instrument is raised during the cutting process, the intravesical end of the instrument will be lowered, and the loop will then penetrate more deeply into the tissue. At the end of the cut an equal and opposite movement will taper the end of the slice (Fig. 121). This maneuver enables the cutting loop to follow the contour of the capsular cavity. During this phase of the operation the surgeon's head and trunk may be seen to control the movements executed by the loop in the resection zone. Thus, if the right-hand side of the capsule is to be excavated, the surgeon's head and therefore the eyepiece of the instrument will move medially so as to impart an opposite movement at the site of operation: the loop penetrates deeper into the right lateral lobe.

Although this coordination of body movement and loop control arises from long practice, it is by no means an artistic exercise of which only few are capable. All the young urologists we train are able to learn this technique of excavation during their apprenticeship.

A finger in the rectum is able to elevate dorsal components of the prostate which lie immediately anterior to it and offer them up to the instrument, thus partly effacing the curvature of the capsule. This is not possible for lateral parts of the gland, where transurethral *adenomectomy* is entirely dependent on the technique of teaspooning.

Cutting in this vicinity is nearly always by predetermination of the starting point. Each cut begins at the point where typical capsular tissue merges into

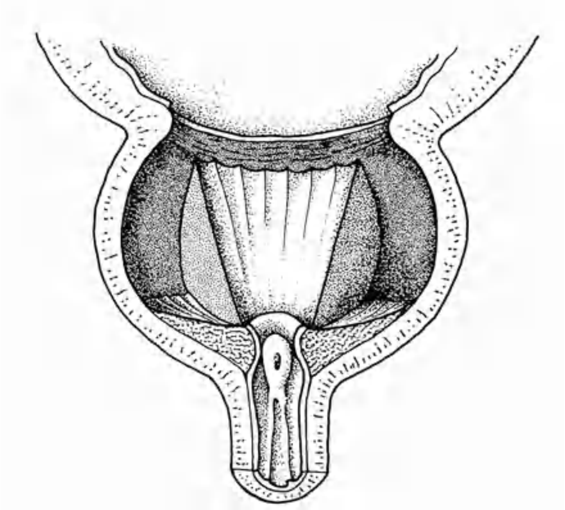


Fig. 121. Excavating the capsule. Only the principle is illustrated: the prostatic cavity has been dissected clear at the left and right margin where only apical tissue remains. This phase of resection has not yet been reached on the floor of the cavity, where the operator may help himself by elevating the prostatic floor so as to efface its curvature. (The actual technique of excavation is discussed in Chap. E in greater detail)

adenoma [see p. 176 and Illustrations 31 and 32 (Plate VI)]. Both illustrations clearly show this boundary between the smooth capsular tissue and the adenoma as it bulges somewhat into the lumen of the prostatic cavity. This is the point where the loop should be placed for the commencement of each cut. The process is subsequently repeated in a like fashion but somewhat more distally, producing a distal extension of capsular dissection.

Extended cuts may be executed in cases of extremely large adenoma, thus requiring the surgeon to combine side-to-side movement of the eyepiece and his head with progressive retraction of the instrument, since the extended cut requires simultaneous movement of sheath and electrotome.

The correct depth of cut is easily maintained if a "marking trench" is first "dug." This trench should be sliced out by the single cut technique, i.e., by a number of individual small cuts working gradually down to the capsule so as to define the available depth of cut for the rest of the procedure. Chapter E provides a more detailed discussion of this entire operative technique.

d) Cutting Rate

The rate of cut, expressed as cm/s, is a factor not to be underestimated during electroresection.

Simply expressed, the faster the loop moves through tissue, the less the thermal damage, and vice versa. The possible rate of cut depends not only on the surgeon's technical ability but also on parameters of the cutting current, and apart from a few technical limitations the situation is easily summed up:

the greater the power output of the diathermy, the faster the loop may travel through the tissue. A weak current (low setting of the intensity control) will require the loop to move extremely slowly if a smooth cut is to be achieved. Higher control settings allow a virtually unlimited speed of cut. Finally, tissue factors – mainly the water content – will also affect the rate of cut. Bladder neck fibrosis and ring strictures consist of fibrous tissue of low water content and are more difficult to cut than the solid tissue of prostatic carcinoma. These problems are mentioned here only briefly and for the sake of completeness, since a more extensive and accurate description is given in Sect. B.III in relation to the use of high frequency current.

The following should, however, be said in conclusion: The surgeon must always aim to cut as fast as possible with the lowest suitable current setting. A high rate of cut permits considerably better orientation, since the tissue surface will be less disrupted. Individual tissues are more easily recognized and the full range of anatomic landmarks is then available to guide the operation.

These remarks have only limited applicability to older equipment employing spark gap generators. In my own experience, however, such apparatus has been completely superseded.

V. The Recognition of Individual Tissues During Surgery

1. Preliminary Considerations

In recent years a number of technical improvements in the resectoscope have greatly augmented the ease of orientation during transurethral surgery. Nevertheless the Old Masters of transurethral technique were able to provide histologic proof of their ability to recognize individual tissues endoscopically (BARNES 1943). Orientation by anatomical landmarks is as valuable during transurethral surgery as during any open operation.

Modern optical systems are so superior in both brightness and resolving power to those previously available that the up-and-coming generation of urologists will find the recognition of individual tissues far easier. The operative field is more brightly illuminated, and a variety of teaching attachments have greatly simplified the demonstration of the numerous tissue structures. Thus the trainee is fully conversant with the endoscopic appearance of individual types of tissue long before undertaking his own first cut. Because of the great variability in the appearance of these structures, live demonstration can never fully be replaced even by the most refined photographic technique.

There can be little doubt that frequent observation of demonstration resections is the best means of learning to recognize tissue differentiation. Nonetheless, this chapter will present a detailed description of each type of tissue, since only a high degree of familiarity will permit proper anatomical dissection.

2. Surgical Anatomy

Operation is aimed at complete removal of hyperplastic adenomatous tissue from the so-called prostatic capsule. Two types of tissue are thus of particular interest: the tissue of the capsule and that of the hyperplastic gland. While the capsule always appears as coarse fibrous tissue, the gland may show a variety of hyperplastic forms.

In strict anatomical terms, so-called prostatic hypertrophy is an adenomatous fibromuscular hyperplasia of individual groups of glands in the vicinity of the prostatic urethra, the stimulus to growth apparently arising from abnormal hormonal control. Three tissue elements are thus involved: gland, connective tissue and smooth muscle (insignificant proportions of striated muscle) which may make up the tissue in varying proportions. The so-called surgical capsule, a zone of true prostatic tissue compressed against the anatomical capsule by hyperplastic tissue, cannot be discerned from the latter endoscopically. The appearance of adenoma tissue will vary according to the predominant element in the growth. In cases of mainly adenomatous hyperplasia the endoscopic appearance will be determined by the transected gland element. In fibromuscular hyperplasia (rare) they are virtually absent. The picture is further altered by the state of the glandular tissue. Marked inflammatory change gives rise to a different appearance to that of bland uninflamed adenoma. Only considerable experience and the availability of modern telescopes with their brilliant image enable the fine detail of such change to be recognized.

The ejaculatory ducts are not infrequently cut into during resection, since they run in a dorsolateral to ventromedial direction from the ampullae into the paracollicular region. Since the duct traverses hyperplastic tissue, any thorough resection is bound to enter its lumen at some point. Depending on its state of repletion this lumen will appear larger or smaller.

The field of resection is delineated proximally from the bladder by fibers of the so-called internal sphincter. These bundles encircle the whole bladder neck and progressively constrict the lumen of the prostatic cavity toward the bladder. Its fibers should be recognized not only as an optical boundary line, but also because of the importance of sparing them. Unduly deep incisions in this region may lead to subtrigonal perforation or, more laterally, to free perforation of the vesicoprostatic junction.

The outer surface of the prostatic capsule is invested with fatty tissue, which may become visible at any time during resection if the capsule is too deeply incised. The appearance of fatty tissue is thus a definite indication of incipient or complete perforation.

Chapter F provides a detailed anatomy of the vascular supply.

Concretions are not infrequently formed within the glandular duct system of the prostate. Adenoma formation will displace these laterally toward the capsule, together with true prostatic tissue. The emergence of this calculous layer thus announces that the surgical capsule has been reached, i.e., that one is still within the true prostate. This fact is of particular importance in the region of the prostatic apex, since dissection within the confines of this layer of concretions is safely within the capsule and there is no fear of perforation.

Poor drainage of secretions combined with inflammation within the glands may give rise to multiple small abscesses within the adenoma. These may have remained undiagnosed prior to being opened at surgery.

3. Prerequisites for the Recognition of Tissue Structure

The surface of the wound cavity and its tissue structure is easily recognizable only under certain conditions:

1. The current must have a sharp cutting action. If the cutting current markedly damages the tissues, the cut surface will be so altered and the wound cavity so clothed in brown crusts as to prevent any fine distinction of structure. This unwanted effect may also result from slow cutting with a high current intensity and a thick loop. The tissues are thus best demonstrated by a rapid cutting action with a just adequate current.
2. Poor hemostatic technique will permit the formation of a more-or-less thick layer of clot spreading across the wound surface like a red jelly. Even if this layer is very thin or is formed only in depressions and tissue spaces it will nevertheless markedly impede visualization of the wound surface.
3. The fine detail of the tissue is best appreciated if the telescope closely approaches the tissue. One will thus achieve a degree of magnification and powerful optical resolution of fine structures.
4. Illumination should be adequate but not overpowering. If, for example, a demonstration resection employing a teaching attachment or the use of an articulated video tube has required illumination by xenon lamp, normal illumination should be re-employed once the light-hungry beam splitter has been detached. The excess light will otherwise obliterate numerous details and blind the surgeon.
5. A particularly detailed image is obtained by the use of either the cylindrical lens systems computed by HOPKINS or of other derivative telescopes.

4. The Appearance of Individual Types of Tissue

a) Adenoma Tissue

Typical adenoma tissue is easily recognized since its surface appears dotted with fine granules (Fig. 122). When cut relatively slowly this tissue in particular may acquire a brownish tint. In large adenomas, septa of connective tissue may be seen running between groups of glands.

This surface appearance is an artefact due to the cutting current. The thermal effect of the applied high frequency current tears the epithelial lining of transected glands away from its supporting element, and at the cut surface contact with the cutting arc will sinter them into almost homogeneous nodules. These fine irregularities of the cut surface are responsible for the characteristic appearance of adenoma tissue (Fig. 123).

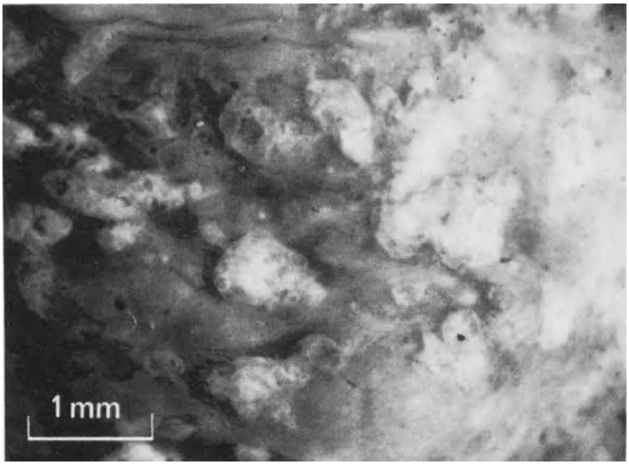


Fig. 122. Macrophotograph of a resection chip showing the typical surface of adenoma tissue. The dots are prostatic glands torn out of their supporting tissues and superficially sintered into lumps of tissue by the cutting current

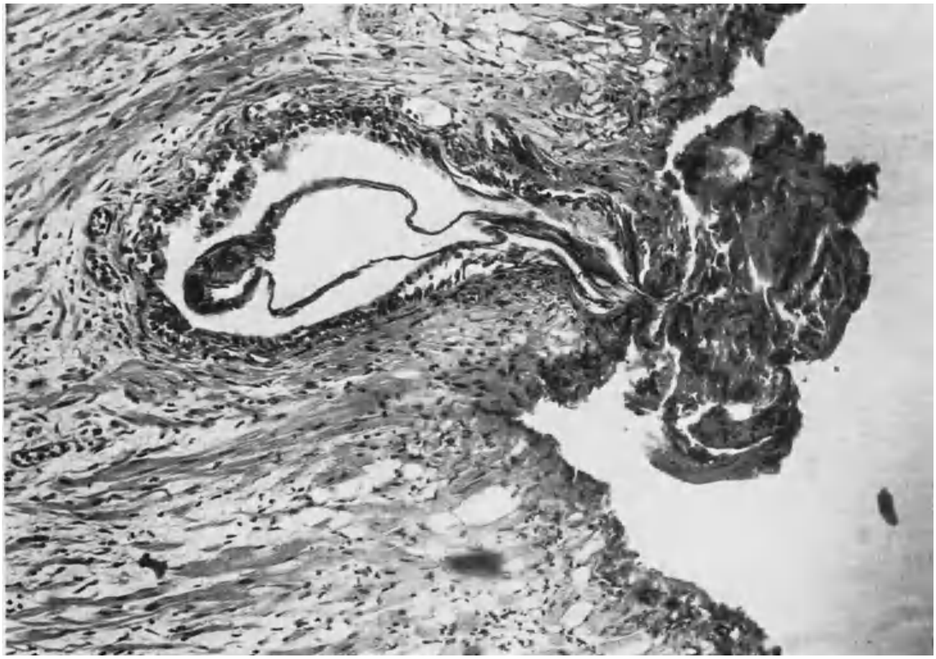


Fig. 123. Histologic section through a dot. It may be easily seen that the dot consists of sintered epithelium torn out of the transected gland ducts by the thermal effect of the cutting current and superficially coagulated into a small lump, the typical endoscopic characteristic of this tissue

As expected, this typical appearance will *not* be seen during punch resection, since the tissue has then not been cut by high frequency current but with a circular knife.

Wide caliber ducts rich in secretion may occasionally be revealed by the flux of minute quantities of milky secretion. Not infrequently, however, a smooth pasty mass emerges from these ducts, appearing in the transected lumen rather like yellowish-white toothpaste. The quantities may occasionally be such that it is difficult to decide whether one is dealing with inspissated secretion or an abscess, the only clue being the presence or absence of a membrane lining the abscess cavity. As a general rule the pus of a prostatic abscess is considerably more viscid than this paste.

The recognition of adenoma tissue means that at this point the prostatic capsule has not yet been reached and resection should proceed to a greater depth. How much deeper, however, can only be determined by a marking trench – not by the surface appearance of the tissue. A number of typical appearances of adenoma tissue are illustrated in Plates V and VI (Illustrations 28–30 and 31–35). Detailed descriptions are given in relation to each illustration. Illustrations 25 (Plate V) and 36 (Plate VI) demonstrate the first few cuts of a marking trench.

b) Fibromuscular Tissue

Pure fibromuscular hyperplasia is extremely rare. The typical dots of adenoma tissue are more rarely visible in this type of bladder neck hyperplasia. Individual gland ducts are seen within a homogeneous and unstructured ground substance. This tissue is most easily discerned by first exposing the capsule proximally at the transition to the parallel fibers of the internal sphincter. At the boundary of proximal capsule and more distal fibromuscular tissue, the individual characteristics of and differences between these two structures may be easily studied. The floor of the prostatic capsule is most suitable for this comparison.

Illustration 35 (Plate VI) conveys a good idea of this type of tissue. Only a small number of "dots" are visible on the cut surface.

c) The Prostatic Capsule

The fibers of this region are arranged in a network quite different to the parallel arrangement in the internal sphincter. The surface is more homogeneous, and the deeper one penetrates the tissue, the more apparent is the predominant structural element of individual interwoven fiber bundles. Deeper still the bundles are isolated and more widely separated. Immediately prior to perforation fatty tissue may be seen shining through between the ever more sparsely distributed bundles. NESBIT (1954) has greatly emphasized the clinical insignificance of these small covered capsular injuries, through which periprostatic fat tissue makes itself visible. Our experience has been identical. Nevertheless, there is no excuse for carelessness when resecting in the region of the capsule, since a deep free perforation may have serious consequences unless it is recognized early and treated appropriately.

Illustrations 37–41 (Plate VII) demonstrate the appearance of the prostatic capsule in various sets of circumstances. Illustrations 38 and 39 are a good example of widely separated deep fiber bundles. In Illustration 47 the fibers may be seen separated at the point of entry of an artery against a background of shiny periprostatic fat.

d) Fatty Tissue

The transurethral surgeon comes across fat not only at frank perforation but also at a premonitory stage and in the immediate vicinity of large vessels, which tend to be invested in a fine sleeve of fat tissue. This fat glints under illumination rather like a snowcap in sunlight. In addition, various characteristics of the fat may be discerned, e.g., inflammatory or neoplastic infiltration, such as is seen when locally perforating bladder tumors. In the presence of neoplastic infiltration, the fat loses its typical yellowish color, appearing strangely pale and of homogeneous consistency. The usual gleaming of fat droplets in the light is seen only in places, or not at all. Inflamed fatty tissue; on the other hand, retains its typical yellow coloration but is denser and unusually homogeneous. One may come across such tissue during prostatic resection if, for example, the capsule is perforated during a revision operation. The fat then closely and firmly encases the capsule and is of great mechanical toughness. As easily confirmed when operating on bladder tumors, high frequency current cuts infiltrated fat better than normal fat.

e) Sphincter Fibrosis Tissue

This tissue is very similar to that of the iris-like fibrous scar occasionally occurring after resection or enucleation of adenoma. It is of a tough consistency, is difficult to cut and has a finely fibrous structure which is irregular and cannot therefore be confused with the internal sphincter. On deeper dissection through this tissue the fibers of the internal sphincter will suddenly appear once the typical scar tissue has been penetrated.

f) Bladder Muscle Fibers

These are not normally exposed during prostatic resection, but the operator should be able to recognize them since he may inadvertently transgress the boundary of the internal sphincter in a proximal direction and find himself cutting into bladder muscle. He will certainly come to recognize this tissue structure when operating on bladder tumors.

The fibers have a characteristic appearance. They are matted with one another like felt. The individual fiber is coarse and is only separated from its fellows by loose connective tissue. In contrast to the prostatic capsule there is no interspersed ground substance. There is some variation between individual parts of the bladder. The trigonal musculature is rather more closely woven, while that of the remaining bladder shows little structural relationship between individual fibers.

g) Infiltration by Urogenital Tumors

Depending on its histologic properties, prostatic carcinoma may appear in a variety of guises. Well-differentiated adenocarcinoma is quite similar to adenoma tissue although transected gland tubules are more sparse and of wider caliber so that the spots appear coarser. Solid anaplastic or highly cellular cribriform carcinomas show far less structure. The surface is greasy, yellowish-white and of extremely hard consistency. In advanced cases the tissue may be so rigid as to markedly impair movement of the instrument at the beginning of the operation. Frequently a strangely sweet smell on evacuation of the gas generated during resection will betray the presence of a carcinoma.

In a few cases I have been able to observe large crumbling masses of tumor tissue tumbling out of transected ducts. These nests of tumor tissue were so soft and amorphous that they could even be massaged out of their cavities by perineal pressure.

The same may be said of neoplastic infiltration of the bladder, where deeper zones of tumor tissue consume and obliterate the musculature. Less advanced regions of solid tumors will reveal muscle fibers embedded in homogeneous ground substance. When cutting into papillary carcinomas one may often observe a crumbling reddish mass welling up between the muscle fibers.

A similar situation arises if an infiltrating carcinoma of the bladder extends into the prostatic cavity. One may once again differentiate between solid and papillary tumors.

Extension of a prostatic carcinoma into the bladder also has a characteristic endoscopic appearance. The individual appearances seen in the prostatic cavity are then recapitulated in the bladder wall.

Papillary mucosal tumors of the prostatic urethra represent a special entity. They are of epithelial origin yet may infiltrate the prostate or a bladder neck adenoma as papillary carcinomas. Their surface appearance is that of a papillary bladder tumor, yet they infiltrate in cords of cells. If the latter are transected at operation, carcinomatous tissue spills out of the cut tumor peg. This tissue has a crumbling reddish appearance. A curative resection should be so deep as to reach the capsule.

h) Infiltration by Extrinsic Tumors

Tumors of the female genitalia or of the rectum occasionally infiltrate bladder or prostate. Rectal tumors, in particular, may invade the prostate and simulate primary prostatic carcinoma, especially if rectal palpation of recurrences is rendered impossible by previous abdominoperineal surgery.

Adenocarcinoma of the rectum, however, has absolutely characteristic features. The tumor is white, soft and almost crumbly. Mucin production may be confirmed endoscopically.

The appearance of female genital tumors is somewhat less typical and in these cases only a careful history and the histology report may clarify the situation.

i) Ejaculatory Ducts

The ducts are frequently entered during complete resection of a prostatic adenoma, but because of their small lumen they may be so unremarkable as to be overlooked. The duct may be recognized within the field of resection by the slightly brownish tint of its lining epithelium and generally appears as a fine channel distinguishable from a blood vessel by the absence of bleeding and the occasional efflux of seminal fluid.

More proximally the lumen is wider, its size and the presence of septa somewhat reminiscent of seminal vesicles. Once again the brownish appearance of the epithelium and the absence of blood allows a distinction from venous sinuses.

j) Seminal Vesicles

It is rare but not entirely unusual to open the seminal vesicle during a transurethral operation on the prostate. The organ is usually transected tangentially during the attempt to completely remove all the dorsal tissue of an adenoma bulging extensively into the rectum.

The incised seminal vesicle is unmistakable. Its margin is often of a brownish tint, and there is not infrequently a discharge of secretion resembling semen. As shown in Illustration 43 (Plate VIII) a clear view may be obtained of the fundus of the organ and occasionally of its septate structure.

We see this occurrence approximately once a year, yet I have never had a patient who suffered serious consequences. Check cystourethrograms following healing of the prostatic wound in no case revealed retrograde filling of the vesicular cavity from the urethra.

k) Blood Vessels

Their appearance is described and illustrated in detail in Chap. F "Hemostasis."

l) Prostatic Calculi

The presence of calculi is ususally revealed by preoperative radiology. They occur in a vast variety of sizes and have an unmistakable appearance, even though their shape and color are capricious. Calculi ranging from the size of a cherry stone to minute blackish-brown granules ("snuff prostate") may be encountered.

Larger calculi lie in a bed lined with epithelium. They are surrounded by extremely tough connective tissue and may be difficult to extract. It is often only the tip of such a calculus that protrudes into the zone of resection. Once the loop has levered a calculus out of its bed the latter may be recognized as an epithelialized depression in the wound cavity. Not infrequently a cloudy secretion surrounding the stone is washed away as the cavity is opened.

The smaller, darker calculi only rarely occur in larger sizes. They usually lie innocuously within the tissue at any depth right up to the epithelium, where they may appear as black dots.

The endoscopic appearance of prostatic calculi cannot be confused with anything else; illustrations 44 and 45 (Plate VIII) show characteristic examples. Illustration 45 demonstrates a calculus bed epithelialized and containing a substantial quantity of concretions. Since the occurrence of calculi is entirely intracapsular (see Fig. 58), their appearance is safe evidence that the operative field remains within the capsule.

m) Prostatic Abscess

The opening of a previously undiagnosed abscess is an unmistakable and impressive event. The resection area is suddenly obscured by a massive outpuring of pus. Once the abscess cavity has been washed clear of pus, its lining membrane is easily recognized as a reddish, irregularly granular surface, often with parenchymatous bleeding.

Pseudoabscesses look similar, but these are probably merely collections of inspissated secretion or old inactive abscesses. Illustration 42 (Plate VII) shows such thick pasty material exuding from one of these cavities.

VI. Accidental Injuries

1. Injuries to the Prostatic Capsule

a) Preliminary Considerations

The word "perforation" has an alarming quality likely to throw not only the trainee but also the teacher standing behind him into a state of agitation. This reaction is only rarely justified. Even in a teaching center where beginners are trained in transurethral surgical techniques, perforation is an extremely rare occurrence. For historical reasons a number of books devote considerable space to this complications, since it occurred far more frequently in the early years when many surgeons were self-taught.

The fear of perforation also dates back to the apprentice years of every transurethral surgeon. At this stage of his training he will have found difficulty in accurately assessing the volume of the gland and thus have tended to make shallow cuts in areas he could safely have resected more deeply. The fear remains as a psychologic "engram," only lost after much practice.

There is only one type of perforation requiring urgent action, i.e., a broad-surfaced, free, deep penetration of the capsule. For anatomical reasons this rarely occurs purely within the capsule and is far more frequent at the junction of capsule and bladder. It is at this more-or-less acute angle, the waisted constriction between the two unequal spherical organs, that the much feared perforation holes may occur. Within the capsule, cutting is usually more or less tangential to the capsule itself, so that the latter is in turn generally only incised tangentially, and it is thus unlikely that this area will be so deeply penetrated as when the angle between bladder and prostatic capsule is cut across as with a bowstring.

Perforations may be graded in the following fashion:

1. Threatened perforation
2. Covered perforation
3. Free perforation
4. Subtrigonal perforation

It seems sensible to discuss the endoscopic appearance of these perforations in this chapter, since they will lead to a change in the quality of tissue observed during surgery. The clinical consequences of individual types of perforation are here only touched upon since they will later be discussed in detail as operative complications.

b) Threatened Perforation

During the attempt to expose capsular tissue over the entire surface of the cavity it is not uncommon to see an area of diverging fibers of generally decreasing caliber. A similar situation may be seen if one of the large capsular arteries has been opened and coagulated. Once again the vicinity of the peripheral capsule margin is denoted by divergence of the fibers. Periprostatic fat may be visible, covered only by a fine spider's web of fibers. Some years ago, I described this situation as „drohende Perforation" (threatened perforation) (MAUERMAYER 1962). The picture is typical and easily remembered.

Illustration 39 (Plate VII) best resembles threatened perforation. Illustration 38 on the same plate also demonstrates the typical divergence of the fiber structure which so calls for caution. My responsibility to my patients has prevented me from presenting further photographic material of threatened perforation, since it would be unethical to spend time on photography of a situation which might be hazardous to the patient instead of bringing the procedure to a rapid conclusion.

Sequelae. This frequent event has no clinical consequences whatsoever, a fact of which one may convince oneself by follow-up contrast cystography. As long as intraoperative pressures are kept below the usual limit of 60 cm H_2O, there is no demonstrable extravasation. Naturally, irrigating pressure should not be increased without a vital indication once this attenuated area of the capsule has been recognized, and greater caution is also required during aspiration of resection chips. Only profuse bleeding from a large artery could represent such a vital indication for a *transient* increase in irrigating pressure. Once the vessel has been closed the irrigator should be returned to its normal height.

Aftercare is routine with no requirement for antibiotics in a primarily uninfected patient. If hemostasis is satisfactory, the indwelling catheter may be removed on the second postoperative day in the usual fashion.

c) Covered Perforation

These differ from the previous type only in degree. The "spider's web" is absent and fatty tissue is freely visible at the site of perforation. This fat, however, firmly covers the perforated hole, and even if the point of perforation is scanned with the irrigation jet, fat remains adherent to the aperture and at least visibly there is no extravasation.

Sequelae. The consequences of this accident are basically the same as for threatened perforation. Irrigating pressure should be reduced, overfilling the bladder should be avoided and care should be taken to evacuate resection chips without violent pumping maneuvers. There is an added necessity to bring the operation to an early conclusion. If perforation should occur early in the procedure, the beginner is strongly advised to carry out careful hemostasis and terminate the operation. Only an experienced surgeon should risk continuing the procedure with repeated careful inspection of the site of perforation in order to ascertain that adherent fat has continued to plug the hole.

Aftercare in no way differs from that of threatened perforation.

d) Free Perforation

This type of injury cannot be overlooked (Fig. 124) and classically occurs at the vesicoprostatic angle rather than in the capsule proper. A more-or-less obvious hole gapes at the point of perforation and irrigation fluid may be seen to run in and, occasionally, out of it. All layers of the capsule (and bladder wall, if the injury occurs in the classic position) are readily recognizable. Little or no periprostatic fat will be seen at the margins of the wound, and in the few cases that I have myself seen, I was able to observe moderately brisk hemorrhage from venous channels around the capsule. If the irrigating fluid is allowed to drain away under direct vision, a small quantity of blood-stained fluid may be seen to drain from the wound back into the cavity.

Additional factors suggesting perforation are mentioned here only briefly: irrigating fluid deficit, evacuation problems, distension of the hypogastrium, flat manometry curve, extravasation on follow-up cystography, circulatory disturbances.

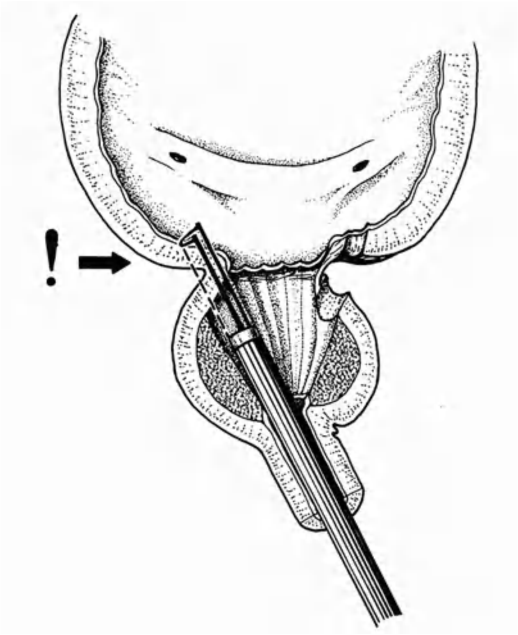


Fig. 124. Diagrammatic cornonal section through bladder and prostate showing typical perforation at the vesicoprostatic junction. On the *right* a peforation, to the *left* the mechanism by which this error occurs. The prerequisite of this injury is that too deep a cut is made at this point without adequate visual control. (Blind application of a loop extended too far out of the sheath. The sheath aperture is unable to press tissue away from the sheath). This is a rare complication always requiring operative intervention

Surgeons accustomed to undertaking TUR under epidural anesthesia report that the patient complains of a characteristic lower abdominal pain at the time of perforation. The occurrence of this alarm signal is indeed sometimes presented as an indication for epidural anesthesia. These additional aids to the diagnosis of perforation are, however, only of significance when operating either with great levity, under poor visibility or with unacceptable hemostasis. Anyone regarding resection as a process of anatomic dissection under visual control must recognize the misfortune of perforation immediately the prostatic and bladder wall have been penetrated.

Sequelae. The only remedy is immediate exposure of the site of injury and oversewing of the same followed by liberal drainage of the paraprostatic and paravesical spaces.

Although accidents of this kind are so extremely rare during prostatic resection, transurethral operating rooms should be so equipped as to permit retropubic exploration, oversewing and drainage in the same operating room and on the same operating table (see Chap. A).

Recognized early and promptly treated, this complication has a reasonable prognosis. Antibiotic cover is advisable and an indwelling catheter should remain in place for at least a week. The transurethral operation may then be concluded at a second sitting.

e) Subtrigonal Perforation

α) Preliminary Considerations. This type of perforation occupies a special position in that it may occur not only during surgery but also before a single cut has been made at the time of introducing the instrument. Only inappropriate advancement of the instrument in a proximal direction enables it to penetrate under the trigone. A precursor of this accident is not infrequently seen as so-called detachment and this is predisposed to by the topographic situation. If a degree of separation occurs between the prostatic capsule at its junction with the bladder distally and dorsal bladder neck fibers proximally, then the capsule may have become so attenuated as to give way at this point. Without any further resection in this area it may be seen later in the operation that the base of the bladder has lifted away complete with the parallel fibers of the bladder neck. The result is a slit opening into a more-or-less deep cleft under the trigone. No other interpretation can be placed on this event than that of pre-existing tension within the tissue leading to spontaneous rupture of the tissue bridge between prostate and bladder in the wake of a general mechanical weakening during resection.

Whether, however, it is justified to interpret such detachment as the result of excessive dynamic intravesical pressure (REUTER 1980) seems to me to be another matter. One would then expect this accident to occur quite frequently in teaching units where the early phases of resection are carried out by inexperienced surgeons. In fact this occurrence is rare. Anyway, the pressures involved are far too low.

β) Subtrigonal Perforation During Instrumentation. Straight instruments which do not follow the urethral curvature and require lowering of their external and raising of their internal end in order to pass the ventral angulation of the bladder neck are more likely than their cranked counterparts to track under the trigone after perforating the dorsal floor of the urethra. BAUMRUCKER has given an impressive description and illustrations of this injury in his original book (1968). The Timberlake-Alcock obturator was devised to minimize this risk. In our own clinic we have never seen such subtrigonal perforation during passage of the sheath, presumably as a result of many decades of experience in passing straight instruments. The straight irragating jet cystoscope of MAY (1953) and straight sounds have taught us to traverse the urethra in this fashion. I am thus unable to discuss the problem in the light of my own experience and can only point to the excellent descriptions given by BAUMRUCKER.

I will, nevertheless, describe a technique for safely avoiding this injury, insofar as I have not already done so when discussing how to pass the sheath (see p. 89). In virtually every case the instrument may be passed without difficulty when guided by a single finger. The instrument finds its own way and only slight corrections of direction and subtle axial pressure are required. During

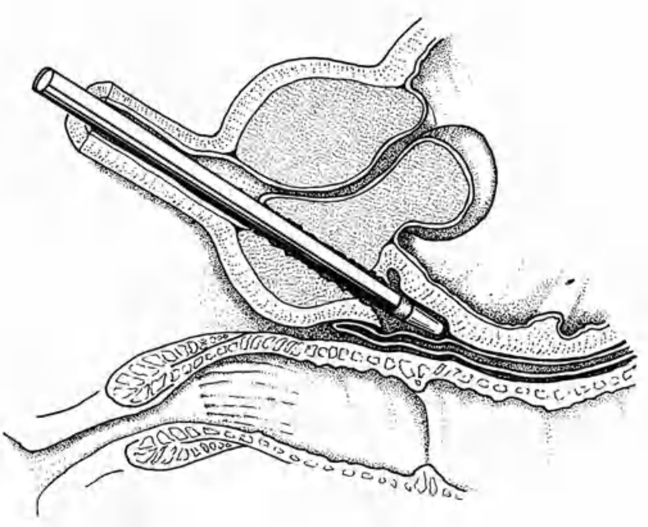


Fig. 125. Subtrigonal perforation. The drawing illustrates this extremely rare event. The resectoscope sheath first penetrates adenoma and then passes through the prostatic capsule in the direction of the trigone. This injury may be reliably avoided by sensitive instrumentation without the use of force. Whenever resistance occurs, it is preferable to introduce the instrument under direct vision, either by a viewing obturator or by means of the electrotome (see also Fig. 124)

our courses on transurethral surgery we have occasionally demonstrated this technique of instrumentation via a video link to a large auditorium. Whenever the instrument spontaneously comes to rest at an insuperable obstacle any attempt at blind instrumentation is immediately abandoned and the obturator replaced either by the electrotome or a viewing obturator (Fig. 125).

Direct vision offers accurate control of any evasive movement required to pass a urethral stenosis or distorsion. The same method will render even the most overweening ventral extension of the median lobe surmountable. If the head of the operating or examination table is lowered, the angle due to ventral extension of the median lobe is easily negotiated. Our yearly workload is approximately 600 transurethral procedures, a large proportion of them carried out by young surgeons under supervision, and yet we have never felt the need for an articulated obturator of the Timberlake-Alcock pattern. Under difficult circumstances visual control is a very much better protection against perforation than any specialized instrument design.

Once this injury has occurred it is mandatory to discontinue the procedure and drain the urine by indwelling catheter for 3–4 days so that the perforation may close. Catheterization may present problems, since the catheter tends to follow the instrument in taking the "false passage." Rectal support of the catheter tip usually succeeds in guiding it upward (ventrally) until it finds the correct pathway. If the fine point of a normal Tiemann catheter causes difficulties, a curved catheter of the Mercier pattern may be substituted.

In conclusion, great importance should be attached to ensuring that urologic technique takes account of this most vulnerable part of the male urinary tract.

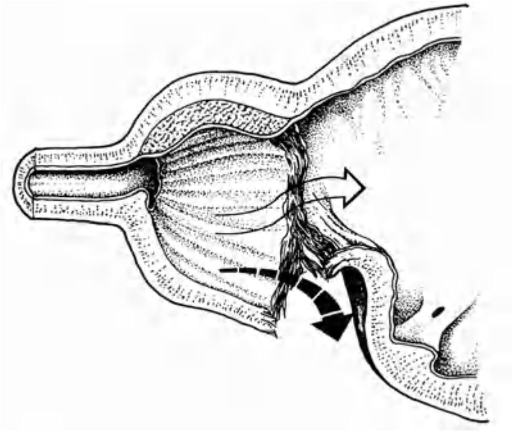


Fig. 126. Intraoperative type of subtrigonal perforation. The tissue between bladder neck and internal sphincter has been too extensively dissected during the course of the operation. This anatomically predetermined weakness gives way. The result is elevation of the dorsal bladder edge and sinking away of the floor of the cavity. The outcome is a slit through the tissues, wide in the midline and attenuated laterally. The event is of no consequence for the patient if it occurs at the end of the operation and is recognized for what it is. If, on the other hand, the operator loses the way in the direction of the **broken** arrow he will pass the instrument under the trigone

Only continuous critical self-appraisal and the proper education of trainees can help to prevent penetration of the subtrigonal tissues.

γ) Detachment. The use of this term in the above sense is due to HÖSEL (MARQUWARDT 1954, personal communication) and applies to a situation described in a variety of publications. It would appear that numerous urologists involved in transurethral surgery have had the same experience. I have drawn attention to the probable anatomical predisposition to this event under α) above.

At an early stage, i.e., before the region of the internal meatus has become separated from the capsule, the endoscopic appearance is one of diverging fiber bundles with fatty and loose areolar tissue visible in the intervening space. Under no circumstances should further resection be undertaken when this endoscopic picture has been seen (Fig. 126).

The event of complete detachment nearly always goes unseen. The fibers of the internal meatus, i.e., the region often referred to as internal sphincter, contract and as it were elevate the base of the bladder upward (ventrally). The result is a slit-like opening of varying depth between prostatic cavity and bladder base. Usually this slit only extends a few millimeters under the bladder neck fibers, but occasionally the floor of the cavity may not even be visible endoscopically. The cavity is lined with fat and fine cobweb areolar tissue.

Sequelae. We have never come across any damage as a result of this event, even in cases where the endoscopic appearance was impressive. Catheterization may nevertheless be difficult. A suitable technique will subsequently be described when complete perforation is discussed.

In cases of detachment the catheter should not be removed on the second postoperative day, as is usually done, but rather left several days longer. Even if the urine was not previously infected, antibiotic cover is recommended. We have never come across an indication for suprapubic exploration. If one examines the bladder neck of these patients at a later date, neither endoscopic nor urethrocystographical change can be demonstrated which would distinguish them from patients who had had a normal bladder neck resection.

δ) Complete Subtrigonal Perforation. This event is prone to occur when an inexperienced surgeon loses his way and allows the resectoscope to slide under the trigone once detachment has occurred. In his attempts to get back into the bladder he then advances the instrument rather than retracting it from the false passage.

The endoscopic appearance is not easily understood, since the experienced surgeon who takes over the case will naturally return the instrument to its proper position as quickly as possible rather than spending valuable time examining the cavity. The immediate aim is to secure hemostasis and terminate the procedure. In the few cases of which I have personal experience, fat and curious cobweb-like tissue structure were the dominant impression. I have never come across serious hemorrhage as a result of this injury.

Sequelae. There is no general rule for the management of this problem. Important points are to carefully examine the perforation from within the prostatic cavity and to control any hemorrhage at that point. A second priority is to achieve the best possible hemostasis both within the prostatic cavity and at its margin while at the same time employing the minimum practicable irrigation pressure and frequent emptying of the bladder. The aim of this is to hold intravesical pressure as low as possible.

Catheterization problems. Under these circumstances it may be difficult to pass a catheter. We always try to use a Tiemann catheter and avoid balloon catheters, since the presence of an inflated balloon in the prostatic cavity may inhibit the drainage of secretion and fluid from the site of perforation. A Tiemann catheter is usually passed with ease if rectal support is used to direct its tip upward. On the other hand, the curvature of a Mercier-tip catheter is less likely to become caught, so it may be worthwhile to try with one of these. Only if both these attempts fail should one use a normal Nélaton catheter with a hollow tip allowing it to be introduced on a curved metal sound.

There was one case in which we were unable to advance the catheter into the bladder by any of the above methods. We, therefore, reintroduced the resectoscope under direct vision and removed the electrotome once the bladder had been entered. A straight metal sound was then passed through the sheath and the latter removed. There was no subsequent difficulty in passing an open-ended catheter with two side eyes over this guide-rod into the bladder.

The use of a ureteric catheter (6 Ch) as a guidewire is a variation on the same principle.

Diagnostic measures following subtrigonal perforation. In this situation a cystogram should be performed under the image intensifies immediately after the procedure. If contrast appears in the subvesical space after the instillation of only a small volume, it is probably safer for the patient to make a small suprapubic incision and drain the left and right paravesico-prostatic spaces.

Extravesical contrast medium may be masked by contrast within the prostate. The area should, therefore, be screened again after removal of contrast medium.

Aftercare. It is unnecessary to suture this injury since it always heals spontaneously.

The case described by BAUMRUCKER (1968) shows that even drainage is not absolutely necessary.

Postoperative antibiotics should be given as a matter of course, and in appropriately high doses if a preoperative urinary infection had been documented.

2. Other Types of Accidental Injury

The various types of perforation together with the appropriate therapeutic consequences have already been discussed above in connection with the endoscopic appearance of various tissues. In the following section we can, therefore, confine ourselves to injuries of the ureteric orifices and external sphincter, intraperitoneal perforation and excessive blood loss.

a) Injury to the Ureteric Orifice

This complication is extremely rare among our case material, and indeed has not occurred at all in the last 10 years. Such an injury can really only arise if the surgeon so loses his way as to believe himself in the prostate when he is actually resecting in the bladder. Such an occurrence nearly always results from several basic mistakes simultaneously: poor hemostasis, inappropriate panic, false pride and poor knowledge of local tissue structure, all leading to loss of orientation.

α) Types of Injury. In the simplest form, there is merely a superficial resection of the orifice. If vacuum tube cutting current with its sharp atraumatic action was used, this superficial injury will heal without sequelae.

I have only come across deeper and multiple laceration of the orifice in a single patient transferred to us as an emergency because of profuse hemorrhage from the resection field. This patient subsequently developed low pressure reflux through the associated orifice.

This is one type of late sequel. The other is stenosis (in this connection see the more detailed discussion of "intentional" orifice resection in bladder tumors, p. 321).

β) Sequelae. Once the indwelling catheter has been removed, one needs to know if there is reflux or whether this will later develop. Extended follow-up will be needed in order to detect cicatricial stenosis of the ureteric orifice. The presence of reflux usually excludes stenosis.

In the immediate postoperative period the use of the slightest pressure during bladder irrigation should be strictly avoided, so as not to cause pyelonephritis by the reflux of infected urine.

b) Injuries to the External Sphincter

α) Preliminary Considerations. There is no exact information in the literature on the frequency of this complication. Any clustering of postoperative incontinence within a unit certainly represents the writing on the wall for the urologist-in-charge and he should make every effort to thoroughly re-examine his technique. It is quite fair to say that a number of cases of postoperative incontinence are *not* the result of incising the external sphincter and, from the point of view of compensation these have an entirely different significance to cases of incontinence due to excessively distal resection. Thus excessive pressure from the presence of a balloon catheter in the prostatic cavity over an excessive length of time may lead to permanent weakening of the external sphincter. A further type of "natural" incontinence is due to infiltration of the sphincter region by invasive prostatic carcinoma, thus impairing its contractility. Finally, there is certainly nothing iatrogenic about the inability of the patient with severe cerebrovascular disease to control his bladder. In the context of these two latter cases the patient or his relatives should be warned of the danger of incontinence at the time of taking consent for operation.

Despite the majority of illustrations in anatomic and urologic works, the external sphincter is not a short contractile ring but a long, muscular tube composed mainly of smooth muscle and capable of responding to faradic stimulation (sphincter test of TAMMEN and HARTUNG 1973, 1976). These fibers continue into the prostatic capsule.

β) Appearance of the Injury. Anyone with any medicolegal experience of this injury will know its anatomic situation. There is nearly always an incision beside the colliculus (which is *usually* still present) running distal to it. Later this may be replaced by scar tissue. Early cases transferred to our unit afford a good opportunity to demonstrate this injury which is reproduced in Illustration 46 (Plate VIII). At a later stage only the principle consequence remains visible and may be revealed by faradic stimulation of the sphincter muscle region and observation of its contraction in the sphincter test of TAMMEN and HARTUNG. Some contraction can nearly always be seen but it is usually only partial and is less vigorous the worse the degree of incontinence. Occasionally the urethra appears as a rigid tube resisting contraction.

γ) Aftercare. If the external sphincter should inadvertently be injured at operation, a balloon catheter should only be placed in the resection cavity and secured under traction on absolutely vital indications. The result of this procedure would merely be to stretch the wound and promote healing in a dilated condition. The indwelling catheter should, however, remain in situ as long as hemorrhage demands. The observation of a distal incision does not always mean the occurrence of incontinence. Treatment should therefore only begin when removal of the indwelling catheter is followed by convincing partial or complete incontinence.

δ) Grading of Incontinence According to Severity. We distinguish three types of incontinence which may be defined urethrographically and urodynamically.

Mild incontinence. This type always improves spontaneously. Its clinical manifestation is involuntary voiding of urine on standing-up, sitting down or other change of posture. These patients are continent when coughing and sneezing.

No injury can be recognized endoscopically. Cystourethrogram reveals a well-filled anterior urethra and an easily visible constriction in the region of the sphincter. Although drug therapy may be tried, the good prognosis of this type of incontinence usually renders it unnecessary.

Stress incontinence. This corresponds to a somewhat more severe injury to the external sphincter. Coughing, heavy lifting or sneezing leads to passage of greater or smaller quantities of urine. Voluntary control of the bladder is possible and activation of the sphincter is able to interrupt the urinary stream. The supine patient is fully continent, but strangely enough his incontinence worsens with fatigue during the afternoon. Cystourethrogram demonstrates almost normal filling of the urethra and obvious constriction by the external sphincter. In such cases we have seen good results with drug treatment with strychnic acid derivatives such as Movellan. (One tablet 7.5 mg two to three times daily; interruption of treatment at weekends to prevent cumulation.)

Complete incontinence. This would appear to be a rare sequel to electroresection, since we are called upon to give an expert opinion on one to two cases per year at the most.

These patients are occasionally capable of continence so long as they remain in bed. As soon as they get up, however, urine leaks out of the bladder, necessitating the wearing of either a penile clamp or a urinal. Voluntary interruption of the urinary stream is either completely or partially impossible despite maximal effort. Urine dribbles from the bladder of the standing patient at the rate at which it is produced. The supine position allows a certain amount of urine to collect in the bladder, rarely more than 50–80 ml. This urine is voided, however, as soon as the patient stands, and he therefore holds the urine bottle to his member before getting up or puts on his penile clamp or urinal.

Cystourethrogram reveals a virtually empty urethra with absence of any narrowing at the external sphincter. Drug treatment is unsuccessful and should therefore not even by contemplated except for psychologic support. Improvement is not to be expected except in the wake of surgical treatment.

The best palliative management of these patients is by penile clamp or urinal.

For some time now the injection of Teflon paste around the external sphincter region has been recommended as a palliative measure in the treatment of this complication. The procedure is described and evaluated in Chap. L.

ε) Conclusion. Permanent incontinence of urine is certainly the most unpleasant postoperative complication a patient may suffer from. Several urologists are therefore usually consulted in succession in the hope of finding counsel and help. The practitiones responsible for the condition often comes to be seen as a personal enemy, and lawyers not infrequently become involved in these cases. The danger of injuring the sphincter is one particular justification for the caution urged throughout this book when resecting apical tissue. Because of the medicolegal implications, it is particularly important to draw attention to the danger of this complication before the patient consents to operation.

c) Intraperitoneal Perforation

We mention this complication here only for the sake of completeness. In over 8000 transurethral operations I have myself never come across such a case, neither by any fault of my own nor as a result of error by a colleague.

This injury may, however, occur during the resection of bladder tumors, and is therefore discussed at the appropriate point.

d) Excessive Blood Loss

This complication is mentioned in many textbooks but is usually the result of an incorrect assessment of the indications for surgery: too large an adenoma is tackled by too inexperienced a surgeon. Apart from the correct choice of operation and surgeon, a variety of safety measures may be adopted:

1. Running estimation of blood loss. We have developed apparatus for use in the operating theater permitting rapid and simple estimation of blood loss. The collecting bucket for irrigating fluid has a capacity of 10 l. As soon as it is full, the blood loss is determined and announced loudly so that both surgeon and anesthetist can hear it. There is thus a running check on the volume of blood loss and the appropriate measures can then be taken.
2. Drained irrigating fluid must be collected. Only this measure will permit any statement to be made on the quantity of blood that has been lost.
3. Only running blood loss determination on small volumes or irrigating fluid (10 l, not 20 l) will allow an up-to-date assessment of the situation.
4. We have conducted tests to show that all subjective estimates are completely unreliable.
5. The technique of Nesbit and Conger employing hematin and hydrochloric acid becomes inaccurate for large volumes of blood, with a tendency to underestimate the true quantity. Any system of continuous blood loss deter-

mination therefore requires the presence within the operating room of easily handled apparatus adjustable for the patient's hemoglobin concentration.

As a result of these concepts we have developed an instrument that satisfies all requirements (HARTUNG et al. 1976). Chapter F gives further details on the technique of using this instrument. If the above points are observed, excessive blood loss can never occur as an unforeseen catastrophe. Even the earliest samples will indicate an excessive loss of blood, and everything possible must then be done to avoid any further increase. If a more experienced surgeon is available in the unit he should immediately take over the procedure. Alternatively, the operation should be cut short after careful hemostasis and if necessary brought to a conclusion at some other time.

Generally speaking, substantial blood loss is not an unavoidable occurrence during electroresection. The only exception may be particularly vascular adenomas in which every cut will open one or several large arteries. This danger will be recognized early in the operation, at the latest after the first blood loss measurements. It will then become necessary to work rapidly and in a particularly bloodless fashion, or else it may become unavoidable to finish the procedure at a second sitting. Such cases are, however, extremely rare. It is certainly completely wrong to fatalistically accept substantial blood loss as a built-in aspect of the technique in the majority of cases.

3. Concluding Remarks on Accidental Injuries

Reading the detailed discussion of accidental injuries just given might easily lead the uninitiated to conclude that such complications are frequent. This is by no means the case. Even in teaching units where young urologists are trained in these operative techniques, the incidence is measured in fractions of a percent. Those of us involved in training apprentice urologists are well aware of the responsibility we bear, and the training methods employed have been described in various places in this chapter. The supervisor first carries out a resection which his trainees observe through a teaching attachment, and the process is then reversed with the master watching the apprentice at work. Our young colleagues gradually progress to a point where they only rarely require help and this method has led to a noticeable reduction in the intraoperative complication rate.

It is implicit in the concept of an operating manual such as this that the book must present all these problems, since the very fact that transurethral surgery is difficult to learn was responsible for its being written in the first place. For this reason the descriptive detail devoted to these complications should *not* be taken as an indication of their frequency.

Chapter E
Special Resection Technique

I. General Considerations

In Chap. D, entitled "General Resection Technique," we discussed the individual elements comprising operative technique. These maneuvers are, as it were, the bricks of which the entire procedure is built. Just as a young cabinetmaker must first learn the proper use of plane, saw and chisel before attempting to produce a piece of furniture, acquiring complete familiarity with individual maneuvers is the only method of learning this operative technique.

This chapter will describe the coordination of such elements into a composite tactical approach to electroresection of the prostate. The greater the quantity of tissue to be removed, the more important is a rational plan of action. Thus there is only a small variety of ways to resect a small transverse bar, while the resection of a large adenoma permits the use of various plans of attack. These questions revolve around two sets of considerations:

1. What is the fastest means of depriving the adenoma tissue of its arterial supply?
2. Which method is most suitable for a given adenoma configuration?

These thoughts will be further influenced by the school in which the surgeon trained and by his personal style.

Our guiding principle shall be that transurethral resection means transurethral adenomectomy. Whosoever contents himself "with cutting a little timid English channel" (BLANDY 1971) might as well save himself the bother of reading this chapter – unless he still wishes to learn the technique. We should not forget that in the early years, partial resection was a standard procedure in transurethral operative technique, a fact evident from an illustration in one of MCCARTHY'S publications dated 1932 (Fig. 127). In the meantime, however, the books of NESBIT (1943) and BARNES (1943), giving detailed descriptions of *transurethral adenomectomy,* have become "bibles" of resection technique, so that the mere excision of a funnel or groove can no longer be considered a complete electroresection. Worldwide experience with the method and the advent of a new generation of urologists have brought the initial epoch of electroresection to a close.

There is indeed a scientific foundation to the requirement for *adenomectomy.* The question is not merely one of honesty or of an "aesthetic" approach to the prostatic cavity, but also one of wound healing. This was clearly explained

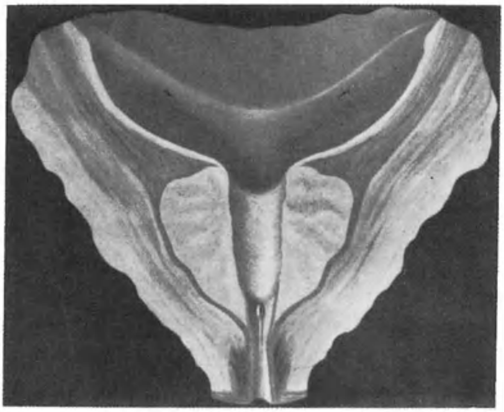


Fig. 127. One of McCarthy's original illustrations (reproduction). This figure is taken from a publication by McCarthy in 1932. It clearly shows the state of the art in resection technique at that time. The bladder neck obstruction was excised as a simple cone. By present day standards this procedure would be regarded as a purely palliative resection

by Flocks (1943) whose chapter on the arterial blood supply of the prostatic bed was based on vascular anatomic considerations.

Furthermore, an inadequately resected prostate has a greater tendency to give rise to "recurrences," if one may apply this term to renewed protuberances of incompletely removed tissue, although it would perhaps be more properly reserved for true new growth of hyperplastic tissue. It is, therefore, not merely misplaced perfectionism for transurethral resection to aim at transurethral adenomectomy.

II. Basic Rules of Resection Technique

The principles to be described are valid for all further operative approaches described in this chapter. The procedure should be divided into three steps (see Fig. 128).

1. Cone excision (Fig. 129):
   The main tissue bulk is resected as a cone, of which the apex lies approximately at the verumontanum and the base circumference in the region of the internal sphincter. This phase of resection will excise approximately two-thirds of the total tissue mass.
   The object of such an approach is to remove the major proportion of excisable tissue in a rapid cutting sequence and without risk of accidental injury.
2. Excavation of the capsule (Fig. 130):
   This phase may also be accomplished fairly rapidly, although it will everywhere expose capsule and transect the main bulk of blood vessels (which should of course be immediately closed by coagulation).

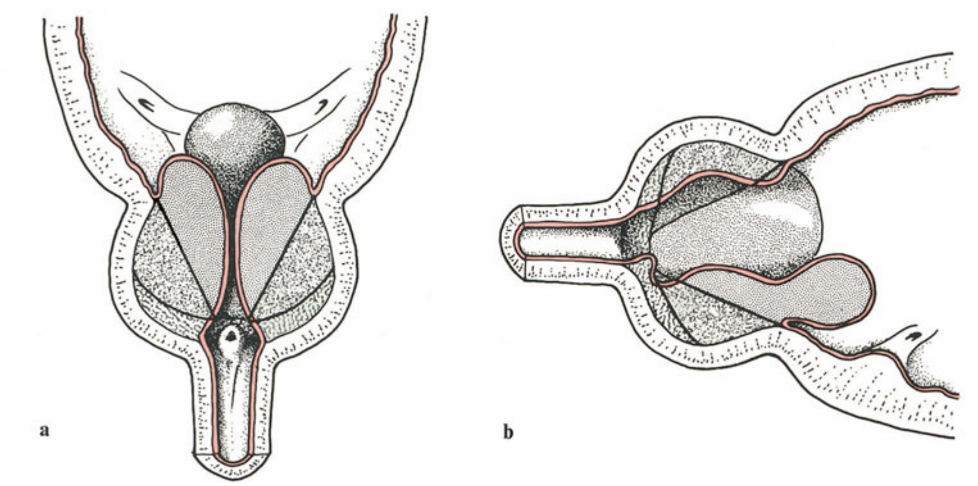


Fig. 128a, b. The three phases of operation. Diagrammatic coronal and sagittal sections. **a** Coronal section through the prostatic cavity and distal bladder. In this diagram the three phases of resection are marked. *Phase 1:* Excision of a tissue cone with its base situated at the internal sphincter. *Phase 2:* Excavation of the prostatic cavity with exception of the apical tissue. *Phase 3:* In the concluding phase of the operation paracollicular apical tissue is removed. *Reasons for this triphasic procedure:* Phases 1 and 2 permit rapid tissue removal, since the danger of accidental injury is slight. The final Phase 3 (close to verumontanum and external sphincter) requires slow careful surgery. **b** The situation represented in **a** is seen here in sagittal section. This is to improve the reader's spatial conceptualization. Comparison of coronal and sagittal diagrams should provide a three-dimensional image of the operative field. For the purposes of this diagram the verumontanum is represented at the point in the vicinity of which (somewhat distally) the apex of the cone should be imagined. Depending on the configuration of the prostatic cavity, the main bulk of tissue will be either dorsal or ventral

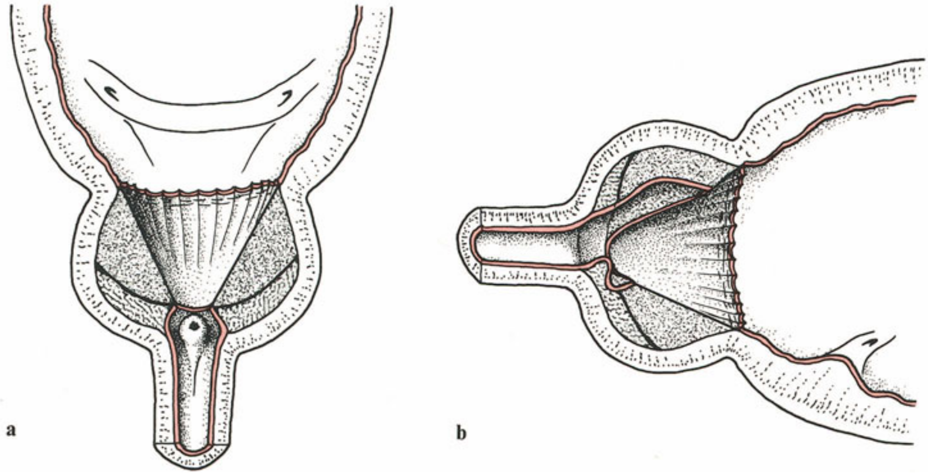


Fig. 129a, b. Phase 1: Cone excision. a The same situation as in Fig. 128a. Zone number 1 in that diagram has been removed. The conical wound cavity is clearly seen, its apex situated in the vicinity of the verumontanum and its base at the level of the internal sphincter. **b** The same situation as in **a**, seen in sagittal section. It may be clearly seen that the mucosa is intact over ventral portions of the lateral lobes

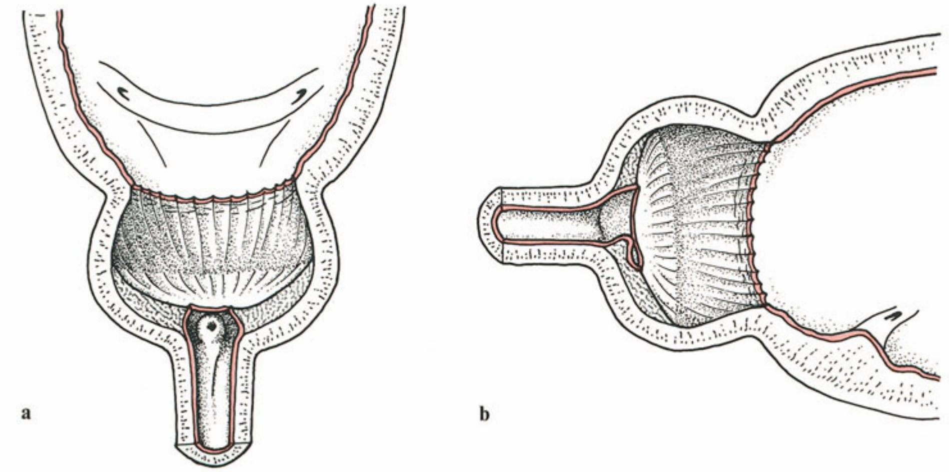


Fig. 130 a, b. Phase 2: Excavating the cavity. a Diagrammatic coronal section. The capsule is more or less clear of adenoma tissue, only the apical parts remaining. View from above into the dorsal half of the cavity. **b** Diagrammatic sagittal section: view into the more or less empty right half of the cavity, only apical tissue still visible

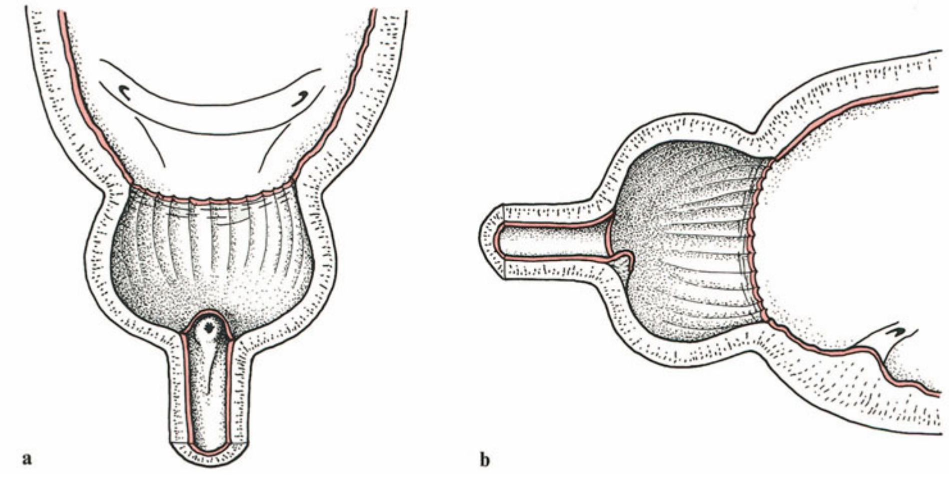


Fig. 131 a, b. Phase 3: Apical resection. a Final arrangement at the end of complete transurethral adenomectomy, seen in coronal section. View from above into the empty dorsal half of the cavity. **b** Sagittal section: view into the empty right half of the prostatic cavity after complete resection of the adenoma

3. Resection of apical tissue (Fig. 131):
   At the end of stage 2, only apical tissue will remain. This third phase is concerned with its removal and requires particularly careful and precise technique to which we later devote an entire section. The third step is of greater importance in determining the patient's fate than those preceding it. Whether this phase of the operation falls short of or exceeds its target will ultimately alone determine whether the patient has a good urinary stream or becomes incontinent.

III. Resection of Small Adenomas

Before discussing individual operative approaches according to NESBIT (1943), ALCOCK-FLOCKS (1943) and BARNES (1943), a brief passage should be devoted to the resection of small adenomas, of bladder neck fibrosis or of transverse bar, since these in fact represent the most numerous type of obstacle to micturition and do not permit the application of the individual techniques just mentioned.

This problem, furthermore, represents the classic indication of TUR, accepted even by those who still firmly believe in the advantages of open surgery.

The principle reasons for this are the difficulty in enucleating small adenomas and the unsatisfactory results for transvesical wedge resection of bladder neck fibrosis.

In the following sections the technique for resecting small adenomas is described in detail. I here present the technique as practiced in our clinic and tried and tested in over 1000 demonstration resections by myself and my assistants for the benefit of young colleagues.

The following description may seem rather exhaustive, but I think this no bad thing since I have been quite unable to find such a detailed presentation and description of resection technique anywhere in the literature. My intentions here are therefore as much didactic as descriptive.

I have dispensed with any mention of hemostasis, since it goes without saying that this should follow immediately on the transection of any vessels. For reasons associated with my preferred teaching method, hemostasis is dealt with in detail in a separate chapter.

1. Step 1: The Marking Groove at 6 o'clock

Resection starts in the 6 o'clock region. Wherever the retroprostatic recess is shallow, cutting should be by predetermination of the starting point (see p. 160). When the recess is deep, the cutting loop may be engaged behind the bladder neck obstruction, energized and withdrawn into the sheath. For safety reasons, the resulting groove should end adequately proximal to the verumontanum, its depth depending on the degree of penetration by the loop (Fig. 132).

The groove should now be extended to end close to the verumontanum by the technique of predetermined end point (see p. 157). This cutting series will thus provide a precise definition of the 6 o'clock position for the field of operation (Fig. 133). In small adenomas or short transverse bars, where little tissue is to be removed, this first cut will expose fibers of the internal sphincter. Indeed, if this is not the case the groove so started should be further deepend until fibers are exposed at 6 o'clock.

Illustrations 19–23 (Plate IV), 25 (Plate V), and 33 and 36 (Plate VI) display these first few cuts.

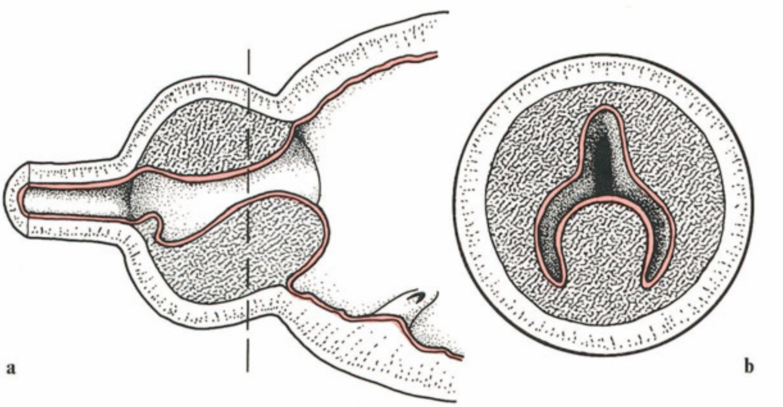


Fig. 132 a, b. Once again two separate views are shown. In the left-hand drawing **a** the right-hand half of bladder and prostatic cavity are seen in sagittal section. The right-hand illustration **b** is the individual phases of operation in cross section, approximately in the rostral third of the prostatic cavity. This twin diagram is once again aimed at providing a three-dimensional impression. **a** Diagram of the starting situation. A small adenoma with marked median lobe development is to be removed. The median lobe bulges somewhat ventrally and obstructs the observer's view from the verumontanum toward the bladder. Mucosal margins are marked in *red.* **b** View toward the urethra from a cut across the prostatic cavity. Dorsally, the median lobe has forced the two lateral lobes apart. In this region the lateral lobes therefore contain less tissue than they do ventrally. The prostatic urethra is compressed by the lateral lobes into the shape of a scabbard, thus appearing slit-like. The verumontanum is covered by the bulge of the median lobe into the urethral lumen

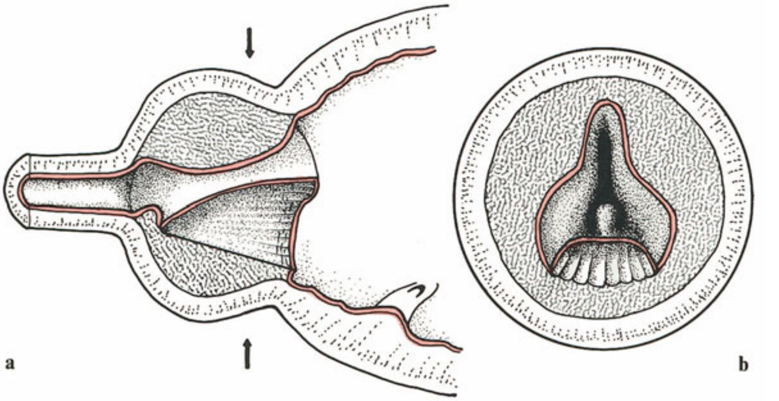


Fig. 133 a, b. (Diagram as in Fig. 132a, b) **a** The first few cuts have been placed along the floor of the prostatic cavity. The bulge of the median lobe into the urethral lumen has thus been so far ablated as to permit a free view from the verumontanum into the bladder. **b** The prostatic cavity seen in cross section. The median lobe has been so far removed as to permit the verumontanum to be seen from the bladder at the bottom of the wound cavity. In the 6 o'clock position the mucosal margin passes close to the edge of the verumontanum on the bladder side

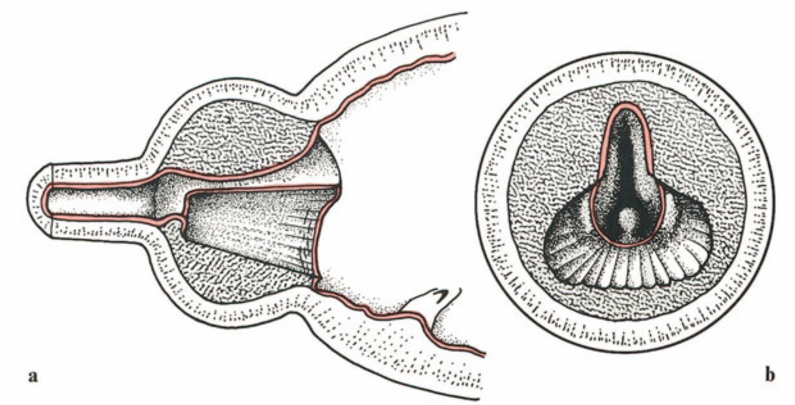


Fig. 134a, b. (Diagram as in Fig. 132a, b). **a** The groove has been extended bilaterally to the 5 and 7 o'clock positions. **b** Lateral extension of the groove seen particularly clearly in this cross section

2. Step 2: Extending the Groove Laterally

Depending on the extent to which lateral tissue bulges medially, this groove is now extended to the left and right to create a freely visible gutter (Fig. 134).

3. Step 3: Deepening the Groove down to the Capsule

This gutter is now deepened down to the prostatic capsule. Great importance attaches to this, since it allows the depth of the prostatic cavity to be estimated (Fig. 135). The less practiced surgeon will carry out this step by small separate cuts while his experienced colleague will use the extended cutting technique. Whether a finger is used in the rectum to provide support by pressing the tissue upward is more or less a matter of personal style and experience. I myself go solely on the appearance of the tissues, although in earlier years when our optical equipment was not of its present standard I tended to guide myself with a rectal finger. This additional aid certainly helps the beginner and gives him some impression of the volume he has to remove.

Appearance at the end of Step 3. The conclusion of Step 3 leaves a broad trench at 6 o'clock. The trench has three main functions:

1. A limited zone of capsule is exposed.
2. The prostatic cavity is of known depth.
3. The lateral lobes previously held apart by basal tissue will now move medially. This renders them easier to assess and more accessible for resection.

Exposing the entire longitudinal extent of the capsule in the 6 o'clock position provides a good resection guide for the lateral lobes.

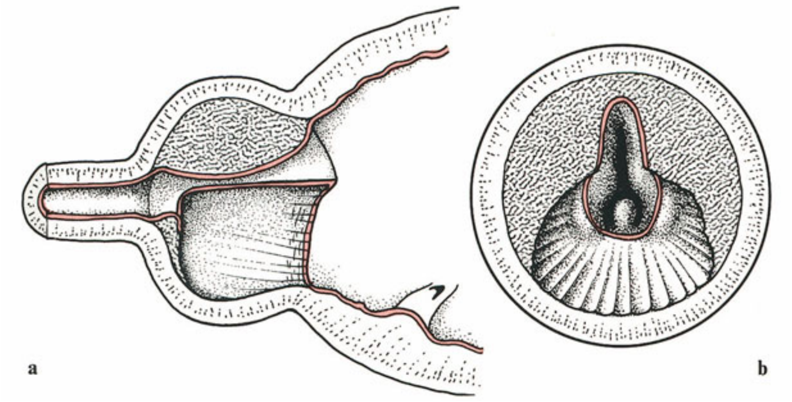


Fig. 135a, b. (Diagram as in Fig. 132a, b.) **a** This phase of resection has exposed the floor of the prostatic cavity. The reason for this procedure is that premature cutting into the depths of the lateral lobes will permit them to fall together in the midline and thus considerably obstruct further surgery. If the resection area is therefore initially extended laterally (Fig. 134a, b), enough space is created to allow this decisive step to be taken without fear of hindrance. **b** The dorsal excavation of the wound cavity is clearly seen

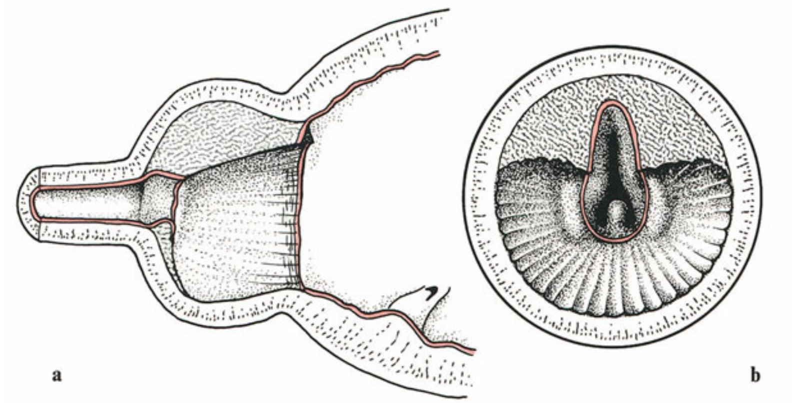


Fig. 136a, b. (Diagram as in Fig. 132a, b.) **a** After exposing the prostatic floor the median and upper zones of the lateral lobe may be resected. Resection proceeds symmetrically until only a small tissue residue is left between 11 and 1 o'clock. This uppermost portion is left until the end because it may require the instrument to be held differently (see text). Once again the apical region is left untouched. **b** Cross section provides the best impression of this stage of the operation. At the end of this phase, only a small tissue residue remains in the roof of the cavity

4. Step 4: Removing the Lateral Lobe Base

The basal moiety of one or other lateral lobe is now removed. It is of no importance whether one starts on the left or on the right, although virtually every surgeon will instinctively start on the favorite side he finds easier. The process starts in a fashion similar to the initital cut. One area is resected until

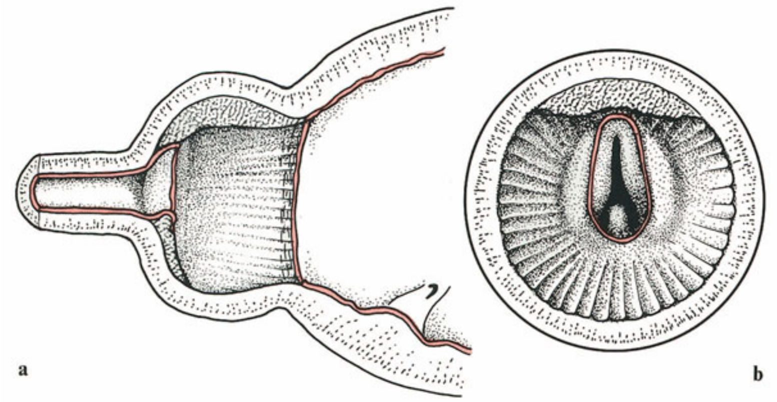


Fig. 137a, b. (Diagram as in Fig. 132a, b.) **a** Situation at the end of the previous phase. It is not always necessary to rotate the instrument through 180° in order to clear this part of the cavity of adenomatous tissue. Occasionally a suitable change in posture may suffice. The previous ablation of basal lateral lobe tissue enables ventral material to drop down, i.e., capsular contraction will offer it up to the surgeon. **b** The sparse residue in the roof of the cavity is easily seen. It is easily removed, being isolated all around

the internal sphincter is exposed, and this cut is then extended distally until capsule is exposed right down to the distal third of the cavity. Even so, a fairly wide safety band of apical tissue will remain (Fig. 136).

The capsular exposure of Step 1 provides a good gauge of the safe depth of cut.

This step is concluded by resection of the opposite side.

Appearance at the end of Step 4. The bulk of the tissue has now been removed bilaterally to the 3 and 9 o'clock levels. Only in the paracollicular region has a "protective layer" of apical tissue been spared. The region so far resected will not have presented substantial difficulties since little rotation of the instrument was required.

5. Step 5: Resecting Ventral Tissue

This phase is concerned with the resection of upper, i.e., ventral portions of the adenoma and requires rotation of the instrument through up to 180° at the 12 o'clock position. Many will find orientation difficult in this position, although proper training of the beginner will dispel his fear of this region (Fig. 137).

Only by frequently observing this process through the teaching attachment can one come to understand the landmarks, quite apart from learning the posture required for operating in this region. The simplest method is to begin on one side by exposing the sphincter in the same way as described in previous steps. This will not require so extreme a rotation of the instrument as to necessit-

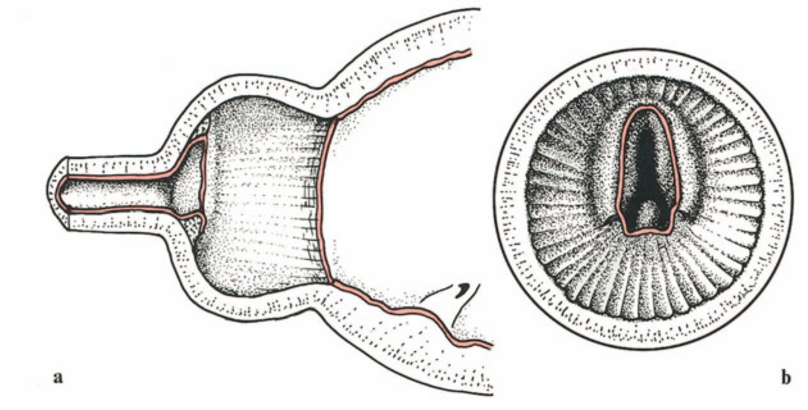


Fig. 138a, b. (Diagram as in Fig. 132a, b) **a** Final arrangement after complete excavation of the prostatic cavity. The capsule is free of adenomatous tissue around its entire circumference but apical tissue still bulges around the paracollicular region like a horseshoe, thus maintaining the slit-like urethral cross section. **b** Cross section at this stage showing why the urethral lumen still appears as a "gothic arch" when viewed from a point distal to the verumontanum

ate a change of hand or grip, since rotation may be compensated for by craning over both neck and trunk. This step in the resection is concluded when both sides have been cleared to the 11 or 1 o'clock level. A safety margin of apical tissue is once again spared.

6. Step 6: Resecting the Roof of the Cavity

Only the residual tissue reaching from 11 through 12 to 1 o'clock now remains. Having been dissected free on either side, it will now hang down into the wound cavity and is easily identified and incised. It is advisable to change grip and completely rotate the instrument through 180° when working in this region so as not to strain one's neck or take up a cramped posture (see p. 131). The internal sphincter has been exposed during Step 5 and further cuts are now placed so as to reduce the remaining tissue from both left and right. These cuts will finally meet in the midline. Once again, apical tissue is spared as in all previous steps (Fig. 138).

Step 6 will thus completely expose the internal sphincter. Its fibers may be identified in all areas, and it remains only to remove the apical tissue. If the bladder neck is 2–3 cm long, approximately 10–15 g of tissue will have been removed. One should not, however, imagine that the resection is now concluded, simply because the instrument does not encounter any tissue when advanced into the bladder!

Appearance of the bladder neck at the end of Step 6. If, at this stage, the bladder neck is now studied with the bladder empty, it will be seen that the newly fashioned internal meatus is not round but slit-like (see Fig. 144). Marked distension of the bladder will convey the impression of a widely open bladder neck and no requirement for further resection (Fig. 145). The fallaciousness of this impression may be recognized by a second sign: if the sheath is now slid in and out in the region of the apex, it may be seen that the apical tissue bulges toward the midline as the sheath is withdrawn and slides back into its original position when it is readvanced (wobble test, see p. 211, see also Fig. 146).

7. Step 7: Resection of Apical Tissue

a) Preliminary Considerations

The following concluding phase of resection is undoubtedly the most difficult and that with the most serious consequences. It is resection in this region which decides between incontinence and good urinary stream. Furthermore, incontinence may even occur in the presence of a poor stream:

The explanation for this key role of paracollicular resection is in fact a simple one:

1. The external sphincter is situated in the region distal to the verumontanum and is to a large extent responsible for continence. Any injury will lead to its more or less pronounced failure and thus to incontinence.
2. The caliber of the resected area in the vicinity of the bladder is of little consequence for the quality of micturition as may be seen by considering the example of two funnels. Only at the point where the prostatic cavity contracts into the membranous urethra does the removal of all obstacles to micturition acquire increasing importance. Any narrowing (Fig. 139) of the lumen at this point will affect the rate of urinary flow to its third power. This functional behavior of the paracollicular region has become apparent from experience with revision resections. In many such cases, the removal of a small quantity of residual tissue was enough to bring about a significant improvement of urine flow.

It is paramount that the resectionist understand and subsequently master two points:

1. He must discern tissues with confidence so as to be capable of distinguishing capsule from adenoma tissue with certainty.
2. He must be fully conversant with the topography of the paracollicular region.

Both these capabilities may be acquired during training sessions using a teaching attachment, or even better by observing the process on a video screen, since the optical quality available from articulated beam splitters provides the best reproduction of fine detail.

The teacher observing his trainee's progress through a teaching attachment will need to supervise his apprentice with particular care during this phase of resection and intervene as required.

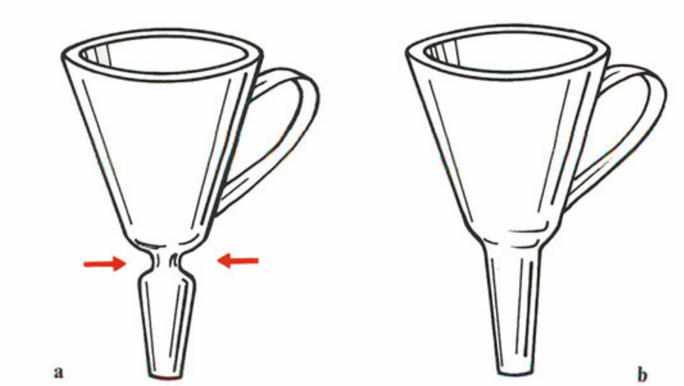


Fig. 139a, b. Comparison to a funnel, showing the significance of apical resection. In both cases the mouth of the funnel is wide enough to allow the copious entry of fluid. **a** The egress of liquid is still obstructed by the constriction between funnel and spout. **b** Only when this constriction has been removed is free flow possible

b) Step 7a:
Apical Resection in the Immediate Vicinity of the Verumontanum

If the verumontanum is inspected from close to, the basal remnants of the lateral lobes will be seen to lie against it and the instrument beak is lowered toward the floor of the cavity. It is as if one were looking into a little valley between two hills. If the instrument is lowered into this "valley," the two slopes – that of the verumontanum and that of the lateral lobe residue – may be pushed apart so as to visualize the cleft between them (Fig. 140). One will then have a clear view of the distal margin of resection and the tissue ring of the prostatic apex.

It is at this point that resection should be initiated, so as both to dissect out the verumontanum and ablate the apical tissue (Fig. 140). Cuts in this region need to be short and shallow (see Illustration 59, Plate X). It is often necessary to dip the instrument deeply into the prostatic cavity or lift up the tissue on the tip of a rectally palpating finger (Fig. 148a, b).

The diagram helps to explain Illustrations 54 (Plate IX) and 55 and 57 (Plate X). In Illustration 54, the resectoscope sheath lies outside the prostatic urethra and the apical remnants of both lateral lobes are thus able to fall together in the midline, their convexity clearly visible. In Illustration 55, the sheath aperture exercises gentle pressure on the floor of the prostatic urethra, thus opening its cleft somewhat. The "valley" between the left lateral lobe residue and the verumontanum may be seen directly above the cutting loop. In Illustration 57, the lateral lobe base has been almost completely ablated. Resection in this region may and should be continued until all the whitish (nonepithelialized) tissue has been removed. The instrument *must* therefore be directed steeply down into the cavity to permit the cut to be tangential to the capsule (see Fig. 159a, b).

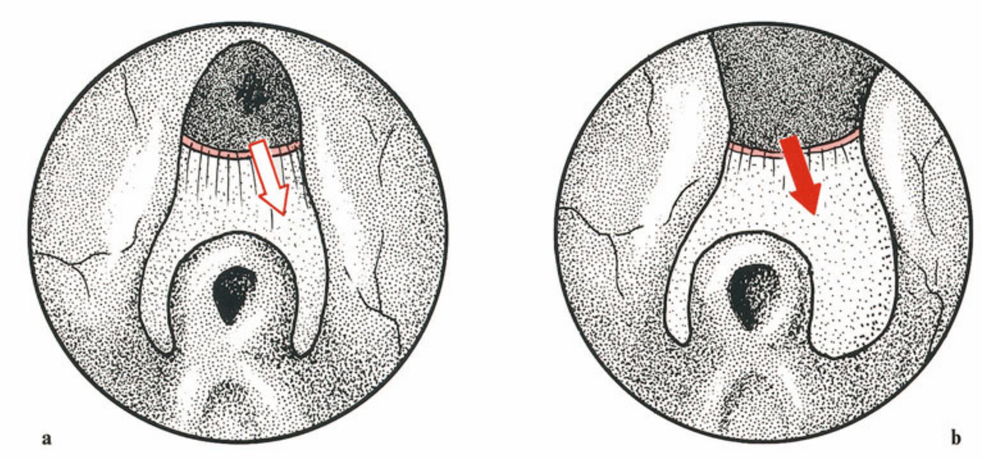


Fig. 140a, b. Diagram of the apical region. The instrument lies in the membranous urethra looking toward the verumontanum. **a** Retraction of the sheath allows the lateral lobe remnants ("apex") to assume their natural position since they are no longer held apart by the sheath. The basal paracollicular tissue is normally so closely applied to the verumontanum that the cleft (*arrow*), here of exaggerated breadth, is hardly visible. **b** If the sheath is now further advanced toward the bladder and depressed into the cleft between verumontanum and contiguous lateral lobe, this region opens up to allow better inspection (*arrow*). The distal edge of the prostatic urethral mucosa (distal margin of resection) comes into view. This configuration is the key position for further prostatic apical resection

Experience is required in defining the margin of this region. The special aids to solving this problem are discussed in detail on p. 209; but the most important ones are briefly mentioned here.

1. Bladder neck configuration: Even during this phase of operation, the lateral lobes maintain their convexity, i.e., they bulge more or less obviously into the urethral lumen. This surface contour is an important landmark, although its optical recognition must be repeatedly practiced by inspection of the bladder neck (see Illustrations 56 and 58, Plate X).
2. Appearance of the tissue surface: As long as adenoma tissue is clearly recognizable there can be no danger of damaging the bladder outlet control mechanism since this tissue is entirely limited to the capsule. Reliance on this feature will, however, require great expertise in tissue recognition on the part of the surgeon (see p. 174).
3. Faradic and hydraulic sphincter tests: the rationale and practice of this aid is described later (see p. 217) and is merely mentioned at this point.

Retrograde cutting is occasionally recommended for resection of this region on the grounds that it is safer. I would discourage any surgeon using this book as a guide from employing that technique since it offends against the basic design of the resectoscope. Instead of ending the cut with the loop in a protected *resting position* within the sheath, the retrograde method requires that the cut be terminated by lifting the loop out of the tissue under conditions of poor visibility and orientation. In place of this I therefore recommend cutting with predetermined end point. One may slowly and safely approach the required

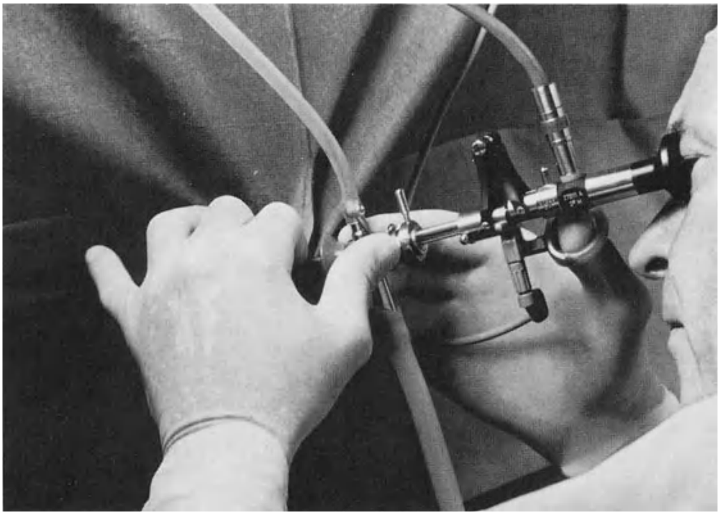


Fig. 141. The resection of the apical region demands particular care, since excessively distal cuts may lead to incontinence. It is therefore vital that the instrument be carefully controlled and steadied. It is useful to brace the little finger of the left hand against the perineum, giving particularly accurate control of proximodistal movements

end point by a slow process of small "nibbling" cuts. Subsequent cuts are made in relation to the end point of the previous one. These techniques were discussed in detail in Chap. D and are only recapitulated here for the sake of rendering this difficult phase of operation doubly clear to the surgeon. Illustration 59 (Plate X) shows this nibbling away of apical tissue.

Paracollicular tissue must be removed first from one side and then from the other. It is usually helpful to observe this region with the bladder empty and to identify apical tissue by sliding the sheath in and out. Many resectionists find rectal palpation equally useful, since it permits an estimate of the thickness of tissue. As already pointed out, I myself prefer purely optical control during this difficult final phase.

Steadying the hand on the perineum. Resting the little finger of the left hand against the perineum may be helpful during this phase of operation. This apparently insignificant device allows the execution of particularly fine and subtle cutting movements (Fig. 141).

At the end of this phase the verumontanum should be completely free on both sides (see Illustrations 62 and 63, Plate XI). It will now be clear how much apical tissue remains in the region of the lateral lobes, since it will be thrown into relief by the groove on either side of the verumontanum.

Inspecting the operative field with different telescopes. The region will appear quite different, depending on the use of an angled or straight viewing telescope. A forward-viewing system will show a cut margin of the bladder mucosa as

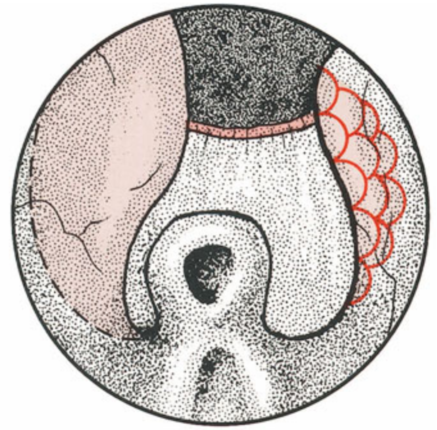


Fig. 142. Diagram showing resection in the apical region. The maneuver shown in Fig. 140b has lifted a lateral lobe remnant away from the lateral flank of the verumontanum. Apical tissue is removed in a series of careful individual cuts. The distal limit is derived from the observation of three important features: configuration of the lobe remnants, appearance of the tissue and hydraulic sphincter test (see p. 217)

a sharp edge and only the distal surface of the lateral lobe remnant will be visisble. More proximal tissue can only be seen by advancing the instrument toward the bladder and slightly abducting it. While such a telescope gives a particularly three-dimensional perspective, use of a 30° lens system gives a bird's eye view of the little mound of lateral lobe residue.

c) Step 7b: Extending the Resection Field Laterally

The cutting out of grooves in this confined space between verumontanum and basal residues of the lateral lobes provides an ideal landmark for further work (Fig. 142). It only remains to remove tissue to the same extent as from 5 through 6 to 7 o'clock (see p. 168). Since the end point for this serial cut has already been determined by phase 7a of the operation, all further cuts will be defined by these two end points (Fig. 143). Resection of the area is complete when all adenomatous tissue has been removed and the capsule is visible. Step 7b is concluded when the 3 and 9 o'clock positions have been reached.

d) Step 7c: Resecting the Ventral Apex

The procedure in this region is the same as in Step 5. The distal end point of each cut is determined by the cut margin created in previous steps. During this phase, the instrument should repeatedly be withdrawn to allow inspection of the field (with the bladder empty) and the tissues should be continually tested by advancing and withdrawing the sheath. *Even in this region* the loose, freely mobile tissue of the adenoma bulges into the urethral lumen as the sheath

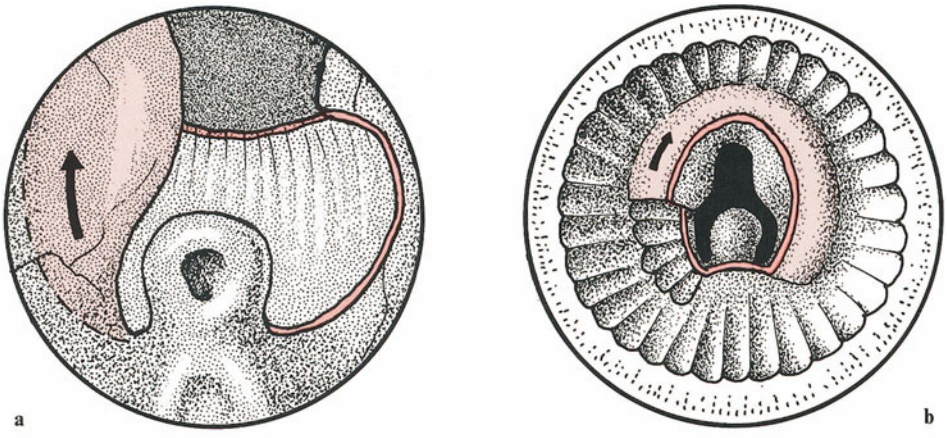


Fig. 143a, b. Appearance of the bladder neck after the first few cuts. a On the left side of the patient (on the right of the diagram) the first few cuts have already been made. The verumontanum is thus exposed and the upper (ventral) end of this cutting series may be recognized in the slightly overhanging lateral lobe remnant. On the opposite side a margin of resection is indicated by the dotted line. **b** Same situation as in **a**, seen in cross section through the bladder neck. The base of the left apical lateral lobe residue has been removed. The mucosal margin is visible at the root of the verumontanum running upward and laterally to the end of this cutting series at the 3 o'clock position. The remaining apical tissue still forms a fold around the urethral aperture and continues to splint it into a slit

is withdrawn. The new internal meatus should acquire a progressively circular shape as the operation proceeds, and we have linkened this to the conversion of a gothic into a romanesque arch. Paradoxically, the urethral caliber becomes progressively smaller since there is less and less adenomatous tissue to hold it open, and the capsule in this region is thus able to retract down to the dimensions of the membranous urethra (Fig. 144).

Once again, this process is best seen using a 0° telescope, since one will then have an almost coaxial view up the urethra. Minimal withdrawal of the instrument during this final phase will render the slightest irregularities in the "romanesque arch" easily visible and remediable, usually with help from the steadying left little finger. When the bladder is empty, the margin of resection should come to lie almost against the verumontanum (see also Fig. 145).

8. Aids to Resection of Apical Tissue

During this description of the individual steps involved in resecting a small adenoma, various aids to better (improved micturition) and safer (avoidance of incontinence) surgery are only briefly mentioned in the text, so as not to interrupt the descriptive flow. These "tricks" are now described and justified individually and in greater detail.

Two such control procedures are purely optical and a third is by palpation. Only the last requires special equipment.

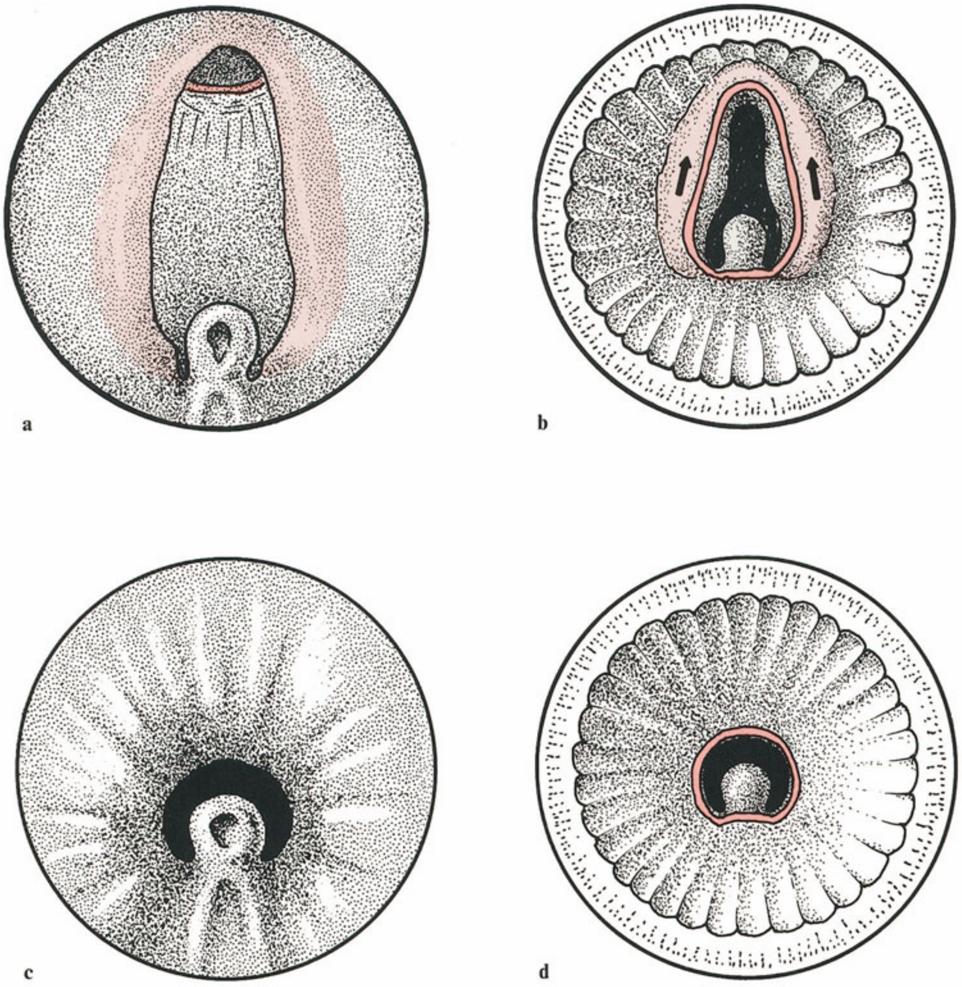


Fig. 144a–d. Appearance before and after apical resection. The endoscopic view is represented in **a** and **c** and a cross section through the prostatic cavity looking from the bladder toward the urethra at **b** and **d**. **a** The resectoscope has been retracted into the membranous urethra allowing the entire urethral slit to be seen from one position. The opening from prostatic cavity into urethra has a tall pointed configuration. **b** A fold of apical tissue still surrounds the urethral aperture and holds it open. A small amount of prostatic urethral mucosa still intrudes into the cavity. **c** After complete resection of apical tissue the urethral lumen *appears* smaller. It now forms a "romanesque" arch over the verumontanum. **d** The apical tissue has been removed and the cavity is completely clear of adenoma tissue. This supporting fold around the verumontanum has been removed, and normal tone now returns the urethral lumen to its usual round appearance

a) Examining the Neck of the Empty Bladder

The prostatic cavity is connected to the bladder and is to some degree, therefore, involved in any movement of the bladder wall. As the bladder dilates, the cavity opens up, only to collapse again when the bladder empties (Fig. 145).

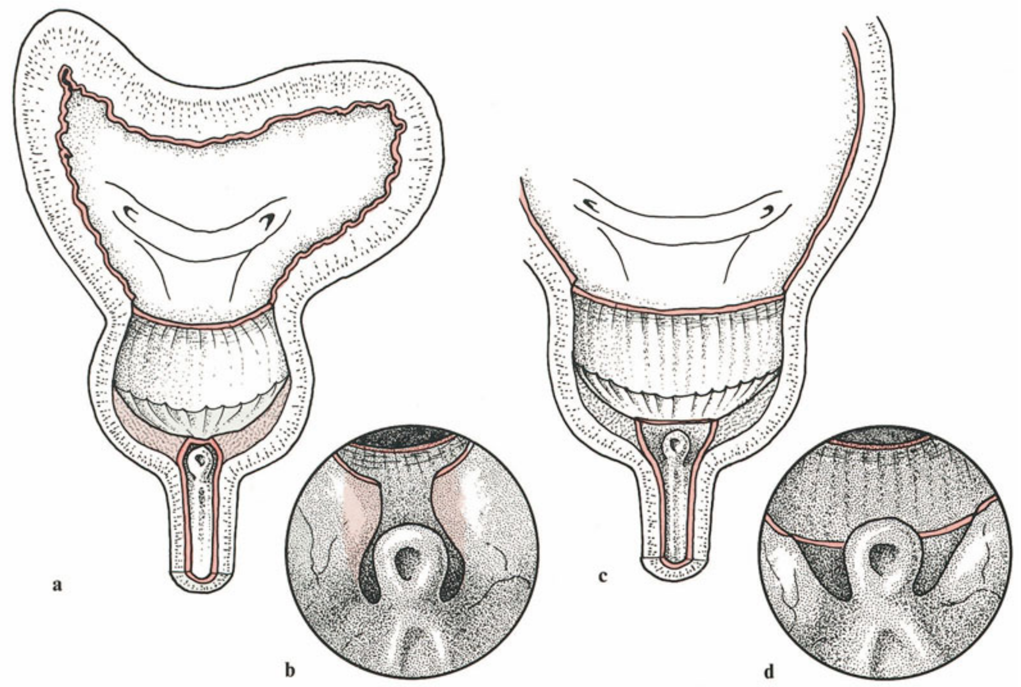


Fig. 145a–d. The appearance of apical tissue with the bladder full and empty. a, b Appearance with an empty bladder. The prostatic cavity expands and contracts depending on the degree of bladder filling. An empty bladder allows a narrower lumen. This results in the advancement of residual apical adenoma tissue into the urethral lumen so that the lateral lobe remnants are closely applied to the verumontanum (**a** Diagrammatic coronal section, **b** Diagrammatic endoscopic image). **c, d** Appearance with a full bladder. The walls of the cavity drift apart as the bladder fills. This movement also involves the apical tissue, which therefore recedes out of the urethral lumen. The appearance of the bladder neck under these circumstances may therefore falsely be interpreted as complete clearance of the cavity (**c** Diagrammatic coronal section, **d** Diagrammatic endoscopic image). Note: Always assess bladder neck and apical tissue with the bladder empty

The capsule is freely mobile and yet the membranous urethra is fixed and the point of transition subject to movement as the bladder fills and empties. Seen in a single plane, this movement resembles the opening and closing of a window shutter, the hinge line being as it were at the transition from prostatic cavity to membranous urethra. This imaginary example may render it easier to understand why apical tissue bulges further into the urethra when the bladder is empty and less so when it is full. If this effect is to be utilized to facilitate resection, the initial cuts must be made with an empty bladder. Since, however, the convexity of the tissue will depend on the filling state of the bladder, only short cutting runs can be employed. In practical terms this means that every few cuts must be followed by emptying of the bladder prior to a further cutting run. It goes without saying that this dynamic behavior of apical tissue does not occur when employing the irrigating resectoscope or trocar drainage.

b) Advancing and Withdrawing the Sheath (Wobble Test)

Adenoma tissue is not tightly bound to the capsule but has highly flexible elastic attachments. If the resectoscope sheath is advanced it will force the tissue dorsally or laterally, depending on the region of the cavity one is working in. Retraction of the sheath, on the other hand, leads not only to the tissue returning to its previous position but will indeed allow it to bulge even further into the lumen of the prostatic urethra, although this mechanism may be inhibited by overfilling of the bladder (see Sect. a).

This great flexibility of the tissue is best understood by watching video recordings of operations one has oneself carried out. During the procedure itself the surgeon is frequently too absorbed by the actual operative event and has little time to observe such niceties. I myself only came to recognize the extreme mobility of apical tissue by watching such recordings.

This behavior is easily harnessed to the purposes of resection, by first of all sliding the sheath in and out a few times so as to fully understand the situation (wobble test). It will then become absolutely clear where resectable tissue remains and where it comes to an end (Fig. 146).

Its resection then requires only one simple maneuver: the sheath should be retracted until tissue protrudes into the lumen. The retracting movement is arrested and the loop passed beyond the now clearly visible adenoma tissue. *The cut should under no circumstances extend beyond what was seen to be mobile.* This process may be repeated several times and represents an ideal supplement to the previously discussed method.

If the technique of end point determination is carefully applied, so as to approach the boundary line with caution, there will be no danger. Previous remarks under Step 7c (gothic – romanesque arch) are complementary to this procedure.

c) Recognizing Tissues Around the Apex

The problems associated with recognizing individual tissues in this region are similar to those encountered more proximally. The point is simply that in this area the surgeon has the danger of incontinence perpetually hanging over him and he is therefore less disposed to rely on tissue appearances alone.

That is of course less true of the experienced surgeon than of the beginner. Many seek to sidestep this danger by leaving a thin safety margin of tissue rather than attempting complete adenomectomy.

The calculi not infrequently found within prostatic glands offer an important landmark of some certainty in this area. They may often be seen through the mucosa, and the associated change has been vividly described as "snuff prostate." The smallest of these concretions may be recognized as minute black dots, whereas the larger ones may be easily seen on X-ray as calcific shadows. On inspection they have a yellowish-brown color, and they frequently comprise a thin skin-like layer. *It is important to note that they occur exclusively within prostatic tissue.* This clustering occurs because the true tissue within which the

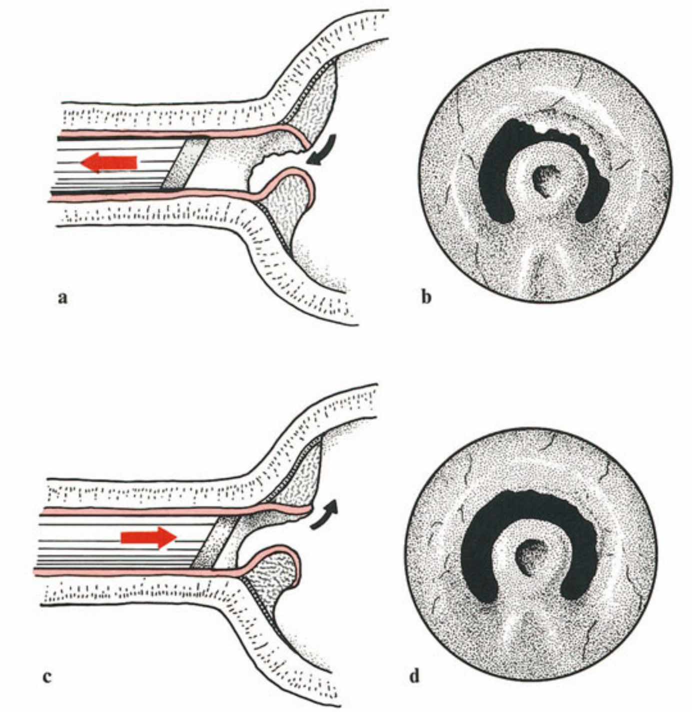


Fig. 146a–d. The wobble test. Changes in appearance of the urethral lumen depending on position of the sheath. **a** Diagrammatic sagittal section. Transition from prostatic to membranous urethra. Retraction of the sheath enables bladder neck tissue to bulge into the urethral lumen. Traction on the mucosa possibly contributes to this phenomenon by pulling contiguous tissues out of the cavity. **b** Endoscopic appearance of the urethral lumen with the sheath retracted. Irregular tissue tags are clearly seen dangling into the ventral urethra. **c** Diagrammatic sagittal section. The sheath has been advanced toward the verumontanum. The previously dependent adenoma remnant has been pushed back into the cavity. Once again it may be that the mucosa is involved in this process by transmitting pressure to the tissues. **d** Diagrammatic endoscopic view. The sheath has been advanced and the urethral lumen appears free of tissue remnants

calculi have formed is compressed along with the calculi by adenoma. As long as calculi appear in the field, one may therefore be absolutely certain of still working within adenoma tissue or in the "surgical" capsule of compressed glandular tissue. Since these concretions and calculi are a really frequent occurrence they represent a valuable aid to orientation (Fig. 147).

It will already be known from experience in enucleative surgery that the transition from adenoma to capsule does not taper to an acute angle but forms a full billowing curve. As a result, resection of this region frequently requires steep angulation or extreme abduction of the instrument to reach into the lateral extremity of the gland, unless tissue is offered up by rectal support. DENIS (1959) has provided excellent illustrations of this situation.

The presence of adenoma tissue at the beginning of the cut is also not a reason to abandon caution. This part of the operation should proceed in

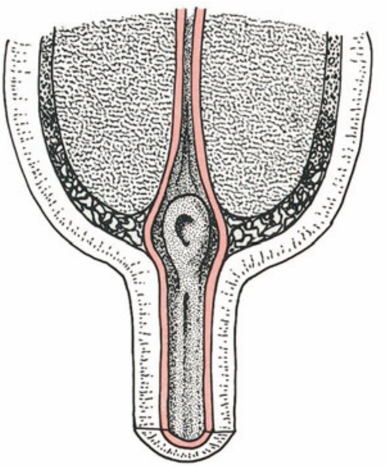


Fig. 147. Prostatic calculi. Diagrammatic coronal section through the distal prostatic cavity and proximal urethra. The adenoma has compressed 'true' prostatic tissue into a thin layer along the capsule. This is the zone where prostatic concretions may be found. Previously distributed throughout the gland, they have been concentrated by the growth of the adenoma into a narrow band. As long as the surgeon remains within a calculous region he may be certain of operating within the capsule, even if the field of resection runs close to and occasionally distal to the verumontanum

small individual bites so as to avoid a cut beginning in adenoma and ending in the sphincter.

The typical secretory tubules of adenoma tissue are often more sparsely distributed in this region and the surface structure may be finer.

d) Rectal Palpationaround the Prostatic Apex

Some urologists (Nesbit 1939; Baumrucker 1946; Iglesias 1948) have attached so much importance to rectal support that they designed special instruments to permit single-handed operating. On the other hand, I have been able to note that others, such as Flocks, stick to the Stern-McCarthy resectoscope with its rack and pinion loop control as their standard instrument. Flocks would only use rectal support in the most unusual cases and he then showed great artistry in controlling the loop with the same hand as he held the instrument.

α) Advantages of Rectal Support. Three objectives may be achieved by rectal support (see Figs. 148 and 149).

1. The dorsal bulge of the adenoma can be compensated for by pressure from the rectum. This avoids the necessity for steep dipping and to some extent for wide lateral excursions of the resectoscope.
2. The thickness of tissue between index finger and resectoscope sheath may be estimated by palpation.

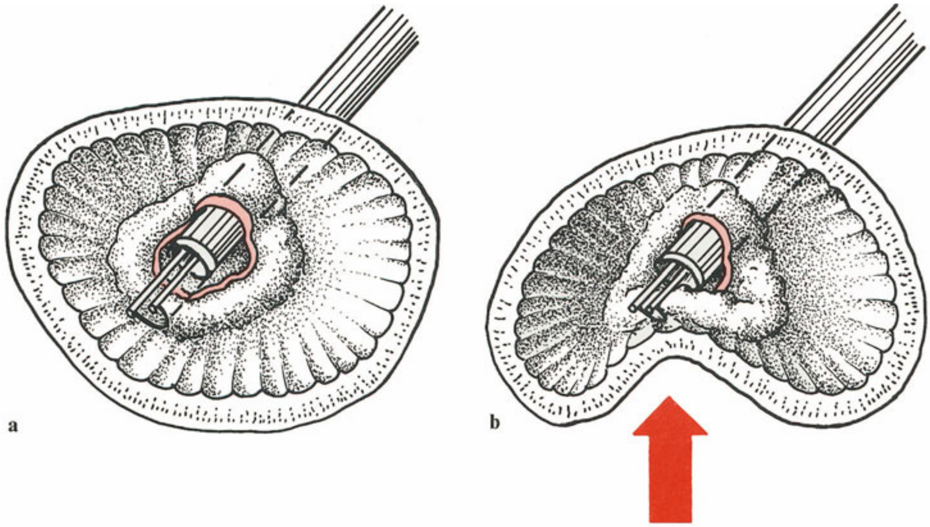


Fig. 148a, b. Two methods of resecting apical tissue from the dorsal cavity. Cross section through the prostatic cavity, seen from the bladder. **a** During the final phase of operation adenoma tissue is to be removed from the prostatic cavity where it tapers down into the urethra. The position of the instrument must therefore be adapted to this anatomical situation, and this demands a steep slant of the tip of the instrument into the cavity (see also Fig. 149a). **b** A similar effect may be achieved if adenoma tissue is lifted up by rectal support, thus avoiding extreme angulation of the instrument. This technique is particularly recommended where prostatic calculi hinder proper clearance of the region

3. In some cases, resection is facilitated by trapping the tissue in an immobile position.

β) Disadvantages of Rectal Support. These advantages should be balanced against the following disadvantages:

1. This phase of operation must be carried out by the single-handed technique.
2. The little finger of the left hand can no longer be steadied on the perineum (see Fig. 91).
3. A false sense of security may arise. Improved three-dimensional perception of the field may lead one to cut too deep and too far.
4. The technique is only effective in the region from 5 through 6 to 7 o'clock; more laterally, the absence of a firm connection between rectum and prostatic capsule will prevent its use.

In earlier years I made far more frequent use of rectal support, but nowadays I employ it less and less.

γ) Pressing Indications for Rectal Support. There are, however, a few distinct urgent indications for passing a finger into the rectum.

1. *Muscular contraction due to cutting current.* Contraction of the levator ani and pelvic floor musculature initiated by the cutting current is of some importance.

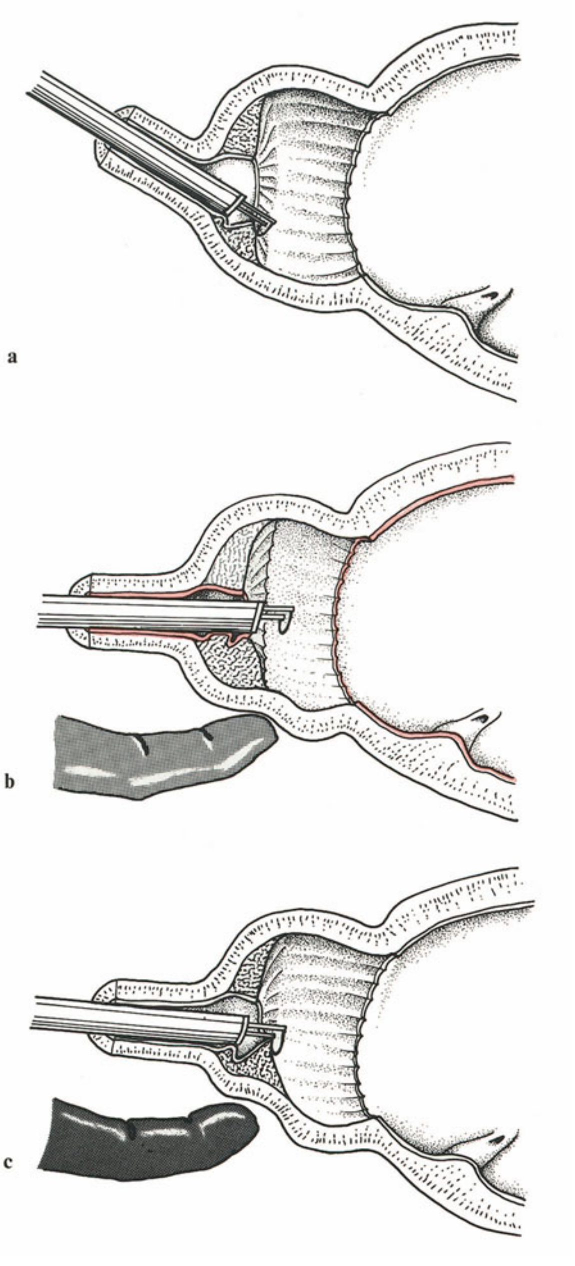


Fig. 149 a–c. Diagrammatic sagittal section through the prostatic cavity which has been cleared except for apical tissue. a Resection of dorsal parts of the apex by tilting of the instrument beak into the cavity (see Fig. 148a). **b** Same situation as in Fig. 148b. Apical adenoma tissue is offered up to the instrument beak. If the sheath is retracted at this point until the verumontanum appears within the field of view, the tissue to be removed is easily pressed into the space between sheath and loop (cutting by predetermined end point). **c** The resectoscope sheath has now been retracted until the verumontanum appeared in the field of view. It is shielded by the sheath aperture and apical tissue is being offered up to the loop

Such contractions not infrequently occur when apical tissue is being resected. Although less rapid in onset than in the obturator region, they may nevertheless cause tissue to be suddenly pressed against the cutting loop with an at least theoretical hazard of perforation or incision of the rectum. Although I myself have never seen complications of this extent, I have frequently had the unpleasant experience of seeing the entire prostatic floor lift up and move toward the loop. During lightning contractions in the obturator region, the very fastest reaction by the surgeon can be nothing more than to immediately switch off the current or withdraw the loop from the tissues. In the region of the apex, on the other hand, one may master the problem by as it were prophylactically anticipating the movement. The tissue is lifted up toward the loop by the finger and held there. Contraction will certainly lift up adjacent regions of the pelvic floor, but cutting of the tissue held up on the finger may proceed uninterrupted.

2. *Prostatic calculi.* These are frequently contained within a cavity which one may open but be prevented by the stone from completely effacing. On the other hand, calculi are easily pressed out of their bed or massaged into a new position. Otherwise poorly accessible deeper regions of the boundary layer between adenoma and surgical capsule are thus rendered accessible. The base of this tissue formation is always somewhat irregular in its structure and smoothing of the tissue is considerably easier if the cutting loop encounters some firm resistance. Rectal palpation quite often reveals further nests which had not previously been appreciated, and palpation is considerably easier if the tissue is allowed to roll between sheath and finger in a form of bimanual palpation (Illustrations 43 and 45, Plate VIII).
3. *Deep dorsal extension of the prostate.* A number of hyperplastic glands have developed so far down toward the rectum as to present considerable technical difficulties of excavation unless rectal pressure elevates the tissues. In these cases it will be possible to palpate as yet unremoved tissue substance between resectoscope sheath and rectal wall. The best information is obtained by allowing the tissue to slide between sheath and finger. This permits exact definition of the various irregularities. Since apical resection usually commences immediately beside the verumontanum and good clearance is usually obtained at this point, the layer palpated near the midline is generally thin, thickening laterally. The art of this type of resection consists of "simply" translating the findings on palpation into a spatial image. It is then quite easy to remove the remaining hyperplastic tissue. The danger of nevertheless cutting too far distally was mentioned at the outset.
4. *Poorly recognizabel verumontanum.* Some types of hyperplasia may make it quite difficult to see the verumontanum (see Illustration 56, Plate X), which in part results from the presence of exuberant folds of mucosa such as are commonly seen after long-term catheterization. A deep groove between the lateral lobes may equally continue distally as a mucosal fold concealing the verumontanum.

   In these cases elevation of the verumontanum by rectal pressure is extremely useful. The urethral wall unfolds and the verumontanum and urethral crest become obvious anatomical structures and useful landmarks.

5. *Papillomatosis of the prostatic urethra.* The verumontanum may be hidden in a similar fashion by prostatic urethral papillomatosis. Furthermore, this fairly soft tissue is far more easily cut if supported dorsally.
6. *Certain types of prostatic carcinoma.* Some forms of carcinoma of the prostate extend so far distally that the verumontanum is barely recognizable. The special techniques to be employed in resecting these cases are discussed in the appropriate section.

e) Faradic and Hydraulic Stimulation of the External Sphincter

Both these alternatives have already been mentioned in Chap. C (p. 217), and since their technique was fully described there, they receive only mention in the present section. Both types of test have a number of advantages:

1. Every transurethral surgeon may now gain exact information on the site of the external sphincter.
2. An excellent technique is available for teaching the young surgeon the anatomy of the posterior urethra.
3. The experienced operator will find a useful place for the sphincter test where previous surgery has destroyed the verumontanum or where scar tissue has altered the appearance of the posterior urethra.
4. In cases where prostatic carcinoma or papillary tumors of the prostatic urethra have led to obliteration of paracollicular anatomy by tumor growth, the sphincter test may usefully be employed. It will also give warning of excessively complete resection where the external sphincter has been rendered partially incompetent by tumor invasion. This state of affairs may be recognized as slow and incomplete contraction.
5. The sphincter test is, furthermore, an outstanding addition to urodynamic investigation of urinary incontinence.

The older and more seasoned operators in our clinic only employ sphincter tests in cases where the anatomy is not clear, but our younger colleagues make regular use of it for both didactic and prophylactic purposes.

IV. Resecting Large Adenomas

1. Preliminary Considerations

Various rational approaches have been proposed to the removal of large quantities of tissue, arising at least in part from a wish to interrupt all blood vessels supplying the prostate *prior* to removal of the main tissue bulk, thus minimizing blood loss during the procedure. This is particularly true of the method proposed by NESBIT (1943) who isolates the main bulk of lateral lobe tissue from the lateral wall of the capsule by a deep trench in which the capsular vessels are coagulated. The remaining tissue may then be rapidly removed without significant blood loss.

All techniques have in common that tissue is resected in three stages, the first one being the removal of a cone of tissue based at the internal sphincter and with its apex near the verumontanum (see Figs. 134–137).

In a second phase, this funnel is extended distally, and in the third and final phase apical tissue is cleared.

The differences arise only in the tactical details of each technique. Which part of the gland is removed first, where should one start and in which sequence are individual portions resected?

The approach is determined not only by an overall scheme of things but also often to a considerable extent by the configuration of the individual adenoma. Thus a large median lobe will require a different plan of action to that suitable for voluminous hyperplastic lateral lobes.

All these considerations will be further modified by the surgeon's own personal style of operating, where he receives his training and the experience he has with a particular method – which he may prefer to apply even where theoretic factors suggest an alternative approach. In other words, a good transurethral surgeon must be highly versatile in order to adapt to all situations.

2. Nesbit's Method

Nesbit gave the first detailed description of his technique in 1943 in his book *Transurethral Prostatectomy*.

The method consists of cutting a trench between prostatic capsule and hyperplastic tissue so as to isolate the main bulk of the adenoma from its blood supply. In a second phase this tissue mass is then rapidly resected with minimal blood loss.

The main prerequisite for this approach is the presence of an adenoma large enough to permit the placement of such a trench. Modest lateral lobe development or predominant median lobe hyperplasia render the technique unsuitable. For didactic purposes, I precede the following diagrams with a general plan (Fig. 150) recapitulating the anatomical relationships.

a) Step 1: Formation of a Ventral Plateau

The procedure starts at the 12 o'clock position with the instrument rotated through 180° to permit easier working in this region. Prior to resection proper, the field is carefully surveyed, since its appearance will be somewhat strange to the surgeon used to starting at 6 o'clock (see Illustrations 11, Plate II, and 16, Plate III). This region of the commissure between the lateral lobes may be asymmetrical in its development and the midline may be displaced from the median plane by disparate development of one lobe. Figures 151 and 152 illustrate the situation at the outset in 3 different perspectives. The distal and proximal limits must be clearly recognized by advancing and retracting the

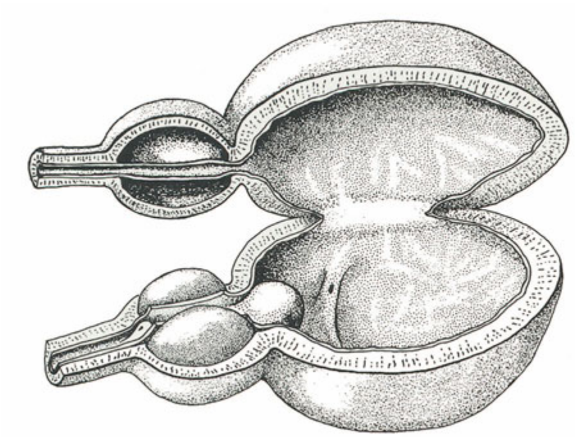


Fig. 150. Anatomical dissection of a bladder, prostate and urethra. The bladder and prostatic cavity are seen in perspective. The two nodules of prostatic adenoma lie in the two halves of the capsule like a pair of flattened eggs. The groove of urethral mucosa has also been divided into a dorsal and ventral proportion as an aid to understanding the relationships. The median lobe covered in mucosa projects somewhat into the bladder

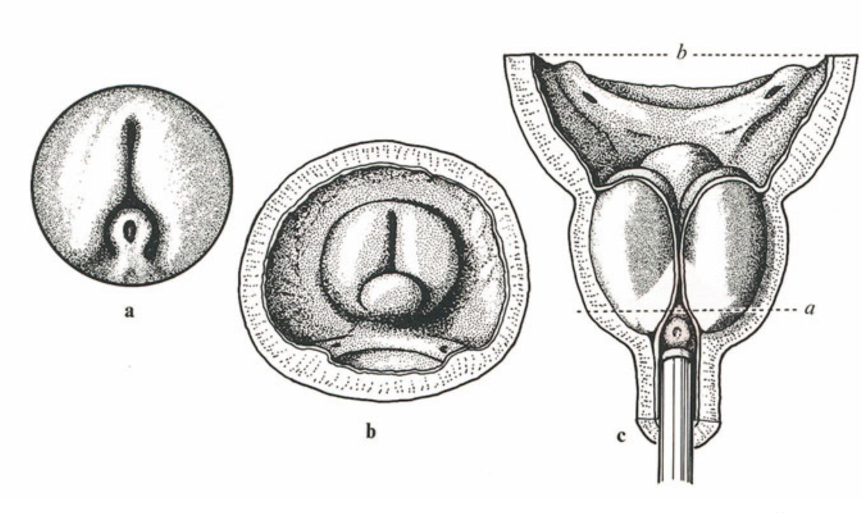


Fig. 151 a–c. Arrangement at the beginning of resection after Nesbit. Once again three different views are given as an aid to understanding the technique and to provide the reader with a three-dimensional impression of the procedure. This subdivision into three views is repeated in Figs. 152–156 so that the individual stages of operation may be closely followed. **a** Diagrammatic representation of the endoscopic view through a forward-viewing telescope. The urethral cleft is seen in the midline as a longitudinal groove, dividing in the dorsal region as the two lateral lobes encompass the verumontanum. **b** Cross section through the bladder slightly above the ureteric orifices and looking from rostral toward the base of the bladder. A moderately large adenoma bulges up into the bladder. Two lateral lobes encircle a moderately developed median lobe. **c** Coronal section through prostatic cavity, bladder and proximal urethra. The ventral half of the bladder has been swung away but the two adenoma nodules left in the prostatic cavity like two eggs in an egg cup. They therefore bulge out beyond the cut edge of bladder, prostatic cavity and urethra

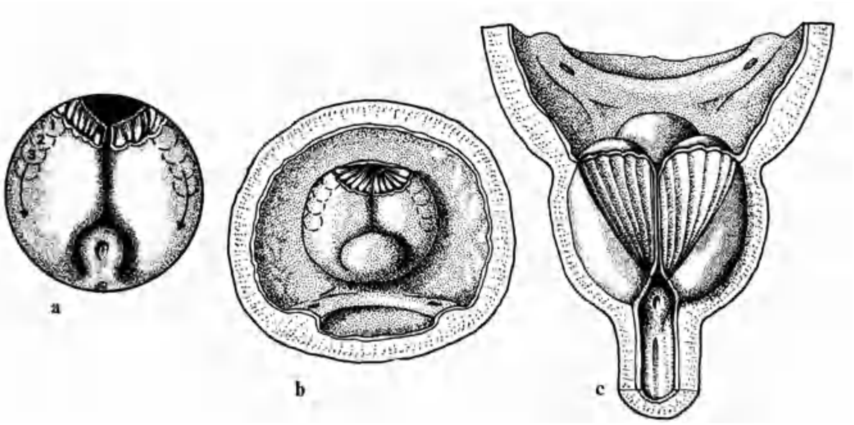


Fig. 152a–c. Formation of the ventral plateau. Step 1 in the method of Nesbit: a Forward-viewing endoscopic appearance. Starting at the ventral extremity of the cavity, i.e., at the interlateral commissure, tissue is removed working from the urethra towards the roof of the prostatic cavity, initially ventrally and subsequently in a lateral direction. The numerals *1–3* indicate the position of successive subsequent cuts. **b** View from the bladder. The ventral tissue at the summit of each lateral lobe has been removed, thus creating a plateau facilitating the next step. This will consist of encircling the lateral lobes and separating them from the capsule. **c** The lateral lobe domes seen from above. Once again, it may be seen how a conical region has been excised from the dome of each lateral lobe

instrument. Furthermore, one or other sphincter test (see p. 217) may be used to provide an additional landmark, should the surgeon be uncertain of the anatomy in the ventral prostatic urethra and its transition to the membranous urethra.

The first cut is made at 12 o'clock or, where the lateral lobes are asymmetrically developed, through the commissure. Since as a rule only a small quantitity of tissue connects the two lobes, one or two cuts may suffice at the proximal margin to expose the internal sphincter. These fibers then serve to mark the proximal margin of resection. A series of single extended cuts is then used to continue the excision distally to the limit of adenoma tissue. As usual, an apical safety margin should be left for protection of the external sphincter.

Once this first cut is complete, a *plateau* should be created. This is achieved by extending the cut laterally to left and right, the end point of the initital channel serving to limit subsequent cuts. The first cut will have defined important limits:

1. The internal sphincter
2. The distal end point of the cut
3. The depth of cut required to reach the capsule

Laterally placed cuts are configured by reference to the first one. I personally prefer to continue with this ventral plateau until the apex of the two lateral lobes has been ablated, before proceeding to the excavation of Nesbit's trench (see Fig. 152a–c).

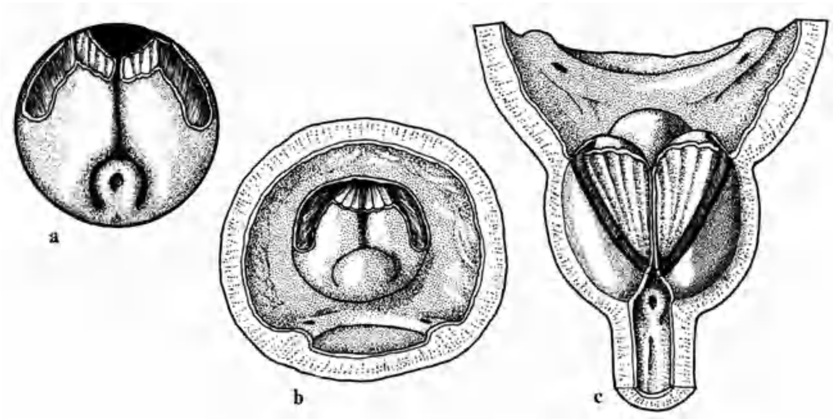


Fig. 153a–c. Second stage of Nesbit's method: Cutting the trench. a Forward-viewing endoscopic appearance. A trench has been cut down from the plateau on either side, thus encircling the summit of each lateral lobe in a conical fashion. **b** The same situation seen from the bladder. Starting at the plateau, the lateral lobes have been two-thirds encircled and thus isolated from their blood supply. **c** View from ventral on to the lateral lobe domes. The plateau created in Step 1 is easily seen together with the adjacent grooves encircling a conical portion of lateral lobe

This procedure provides adequate play for the instrument, space for the drainage of irrigating fluid (with a consequent improvement in visibility) and finally permits good hemostasis of the not infrequent hemorrhage from sizeable arteries in this region.

b) Step 2: Cutting the Trench

Creation of the plateau concludes Step 1. A bilateral start should now be made on the trench (Fig. 153a–c). NESBIT (1943) describes continuing the trench on one side until the 7 o'clock position has been reached and only then proceeds to the opposite side. I prefer to carry out this part of the operation in a symmetrical fashion alternating between left and right. This tends to facilitate orientation.

The landmarks to be followed consist proximally of the internal sphincter and peripherally of the prostatic capsule. Each cut terminates distally, level with the end of its neighbor (Fig. 154).

The first vessels will be encountered quite soon after beginning with this trench. They should be coagulated on the capsular side as soon as they are opened. The trench should be continued bilaterally to the 8 or 4 o'clock position. Careful hemostasis should be carried out before proceeding to the next phase of resection.

c) Step 3: Tissue Ablation

The next step is to remove all hyperplastic tissue to the level of the bottom of the trench (Fig. 155). This may be carried out in a rapid cutting sequence, since there will be little bleeding. It is of great value to support this phase

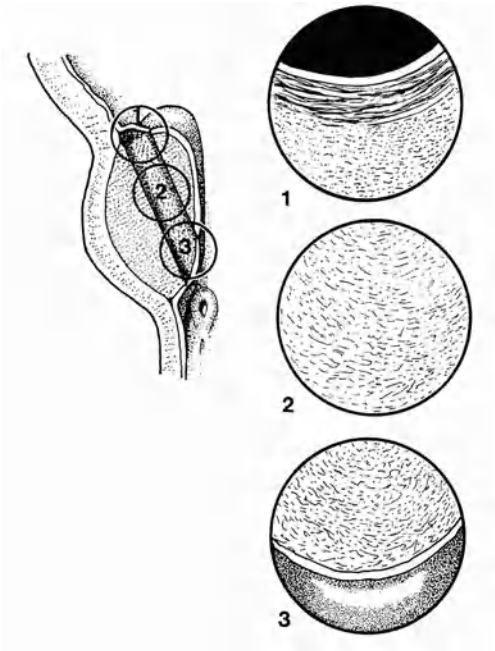


Fig. 154. Aids to orientation when cutting the trench. Diagrammatic representation in coronal section, looking down on to the dorsal half of the prostatic cavity. The cut commences at the transition point bladder-prostate. Landmarks are: fibers of the internal sphincter and the beginning of adenoma tissue (*1*). In the middle of the trench only typical adenoma tissue may be seen (*2*). The cut is terminated as soon as prostatic urethral mucosa appears (*3*)

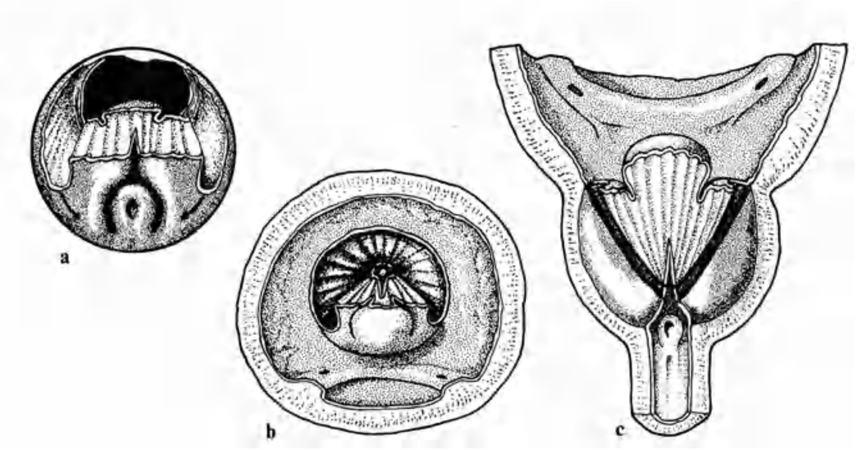


Fig. 155a–c. Third stage in Nesbit's method: Tissue ablation. Previously encircled by the trench, thus isolated from the capsule, median lobe tissue is now removed in successive horizontal layers. **a** Forward-viewing endoscopic appearance. The lateral lobe tissue cones are approximately half excised. The dome of the median lobe has just been incised. **b** View from the bladder. The horizontal plane created by resection in layers is easily seen. A first cut has entered the dome of the median lobe. **c** View from ventral toward the lateral lobe domes. Two-thirds of Nesbit's cone has been removed. This view into the resection cavity provides a good impression of the distal lateral lobe moieties, as yet untouched

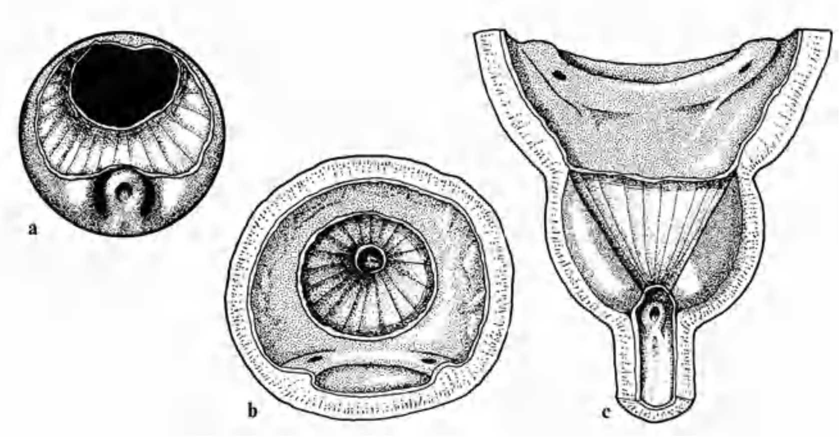


Fig. 156a–c. Stage 4: Resection down to the floor of the cavity. The tissue cone has been excised right down to the floor of the prostatic cavity. **a** Forward-viewing endoscopic appearance. Both lateral lobes and the median lobe have been ablated down to the floor of the cavity. The internal sphincter has been cleared in its entire circumference. Only apical tissue remains. The cavity is not yet, however, excavated (see Fig. 157). **b** View from the bladder. The circular funnel of remaining tissue is seen. At its apex, note the circular mucosal edge around the verumontanum. It is once again clearly seen that the capsule has not yet been excavated. **c** View from ventral toward the lateral lobe domes. The conical space is easily seen, together with the distal untouched portions of the lateral lobes (see Fig. 129)

of the operation with a finger in the rectum, since the somewhat looser tissue has been deprived of its lateral fixation and tends to be mobile.

Tissue removal should, however, proceed layer by layer, working from left to right and back following one carefully placed layer with another. A clearly defined plateau should be preserved since one may otherwise lose one's way. Both lateral lobes are removed from trench to trench in a single sequence. This phase of resection is concluded when the floor of both trenches has been reached.

d) Step 4: Resection Down to the Prostatic Floor

This phase of the procedure is technically as simple as the preceding one. As before, the tissue is removed in horizontal layers from one side of the cavity to the other until fibers of the internal sphincter have been exposed dorsally around their entire circumference (Fig. 156). It is not necessary at this stage to excavate tissue down to the capsule, although that would be particularly easy in this dorsal region. Rectal support will itself provide a good impression of the required margin of resection and is after all the normal procedure for small adenomas. This phase of operation on large hyperplastic glands should be concluded by rounding off and smoothing the cone inferiorly. Only when this has been undertaken and proper hemostasis is complete should excavation of the cavity begin. The process of excavation is the same for all resection strategies, since they all begin with the excision of a central cone around the

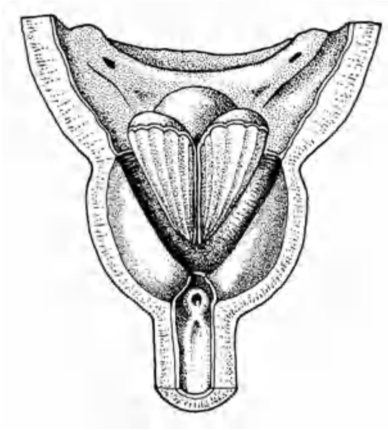


Fig. 157. Diagram explaining cone excision. The tissue cone has been represented by the artist as though it were removed in one piece. It seems to float in the wound cavity. It now remains to clear the prostatic capsule of adenoma tissue by the technique of excavation and apical resection. (After NESBIT 1943)

prostatic urethra, and the differences consist merely in the method of its excision. The state of affairs after removal of this central periurethral cone is demonstrated in Fig. 157, adapted from one of NESBIT'S original illustrations.

e) Conclusion

In the hands of a surgeon who is used to its application, this technically somewhat taxing technique has the advantage of reduced operative blood loss. The blood supply is occasionally subject to variations which may frustrate the intention of dividing vessels at their point of entry into the adenoma. Any surgeon with a degree of experience in this method will remember a number of operations at which hemorrhage from multiple and ubiquitous vessels was difficult to control despite division and closure of the principle channels in the usual way.

There is one further reason why few surgeons – at least on the European continent – adhere exclusively to this method: it is quite difficult to learn the technique, and particularly the obligatory ventral starting point may present problems to the trainee, who will find it easier to orientate himself endoscopically by starting at 6 o'clock. In this position, the verumontanum is directly in view, and the instrument is held in a natural position so as to provide the accustomed picture.

Once a young urologist has become adequately trained to be capable of mastering Nesbit's resection, he will also have become so accustomed to some alternative method as not to wish to change his technique.

In November 1952 I was fortunate enough to spend some weeks observing NESBIT himself at work. The demonstrations with plaster models by which he explained his technique as well as numerous endoscopic demonstrations of the various stages of this procedure impressed me so deeply that from 1952 onward I devoted considerable effort to popularizing the method in Germany. Unfortunately at that time today's teaching equipment was not available (e.g., teaching attachments), so it was many years before I could pass on my self-taught expertise in the way I do today.

I personally recognize one particular indication for NESBIT'S resection: the protrusion of very voluminous lateral lobes into the lumen of the prostatic urethra in adenomas of substantial size, perhaps of over 40 g resection weight.

In small adenomas I find excavation of the trench too difficult and time-consuming since I could have removed an entire lateral lobe in the same space of time.

Furthermore, one needs to carry out a very considerable number of operations every year in order to master the Nesbit technique. Anybody undertaking less than 50–100 resections a year is well advised to employ a technically less taxing approach.

Various of NESBIT'S pupils have modified the method. The reader of CONGER'S monograph (1963) will find few remains of the Nesbit trench in the illustrations, apart from the initial ventral excision.

3. Excavating the Cavity

This technique was already mentioned in Chap. D. It is here discussed in greater detail, since it is common to all resection strategies. It is thus not a specific phase of the NESBIT technique but a recurring theme in all methods of resection. Nonetheless it would seem from conversation during our resection courses that this very "excavation" presents many colleagues with a degree of difficulty.

a) Basic Principles

From a geometric point of view, the cavity may be excavated in one of two ways (Fig. 158):

α) Small Single Cuts. The left-hand half of the figure shows the method preferred by the beginner: he attempts to remove the tissue by numerous shallow individual cuts gradually penetrating the adenoma tissue. This enables the instrument to be kept straight, almost rigid, without the necessity for lateral excursions to drive the loop into the tissues. The result is numerous short resection chips of small diameter.

β) Extended Cutting. The right-hand side of Fig. 158 represents the technique employed by the more experienced surgeon: long slices with a shallow start, but penetrating more deeply into the tissue toward their middle, enable the operator to rapidly approach the capsule. The resulting chips are longer and taper at either end.

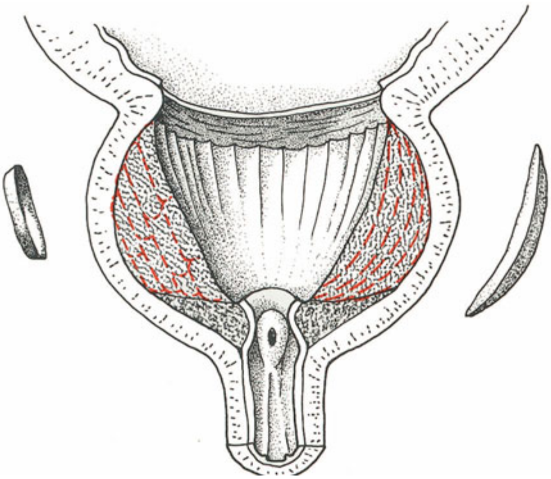


Fig. 158. Excavation technique. Diagrammatic coronal section through the prostatic cavity, view from above onto the dorsal half. **Left-hand side:** Technique of multiple single cuts. This method allows the inexperienced operator to avoid "submerging" the loop. The resulting chips, however, are always somewhat small and thin, and this method is therefore time-consuming. **Right-hand side:** Technique by lateral excursion of the loop ("submersion") into the tissues. The surgeon must not only execute the usual sliding action of the instrument along its axis but must also sink the instrument beak into the tissue and then withdraw it. This results in much longer chips with tapered ends

b) Control of Instrument and Loop

(Fig. 159)

The specific region of the capsule being excavated may require a degree of backup movement by the whole body. It is precisely these coordinated movements which the beginner finds difficult. This gouging technique consists of three components.

α) The Linear Cut. The first component is the actual cutting process which may be termed linear. The loop is extended and returned into the sheath as the cut proceeds.

β) Depth of Tissue Penetration. Throughout this cutting process the surgeon's head, and thus the eyepiece of the instrument, execute an equal and opposite movement to that of the instrument in the field. Abduction of the instrument to the right-hand side of the patient causes the loop to penetrate more deeply into the left-sided tissues.

γ) The Extended Cut: Three Elements Combined. The extended cut required by larger adenomas adds a third component consisting of retraction of the entire instrument.

It is the coordination of these three processes which make the technique seem so difficult to the student. A further geometric factor is worth considering:

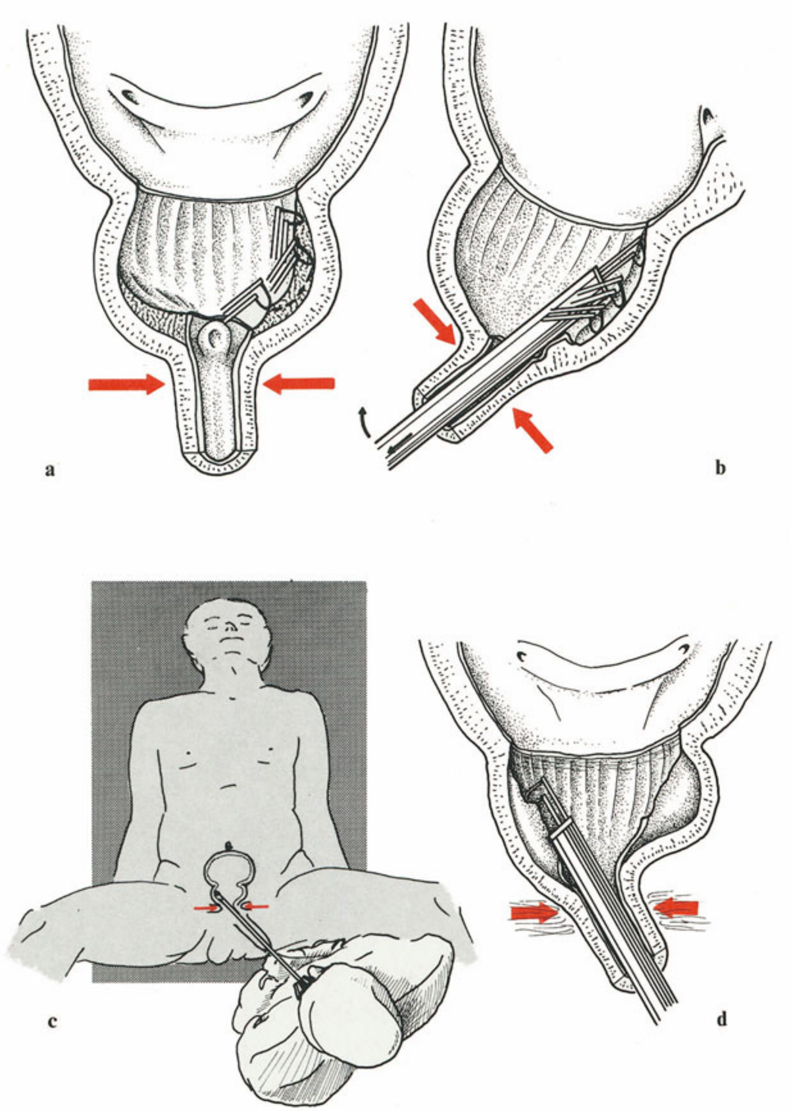


Fig. 159 a–d. Instrument control during excavation. a Coronal section through the middle of bladder and prostatic cavity. The various positions of the cutting loop indicate different attitudes of the sheath. In this case, the sheath has to be sharply abducted to the patient's right (*left* in the picture). **b** Diagrammatic sagittal section through prostatic cavity and distal bladder. *Arrows:* Vicinity of the fulcrum around which the instrument moves as a lever. If the instrument eyepiece is raised, the loop will penetrate more deeply into the tissue to re-emerge as it is lowered. **c, d** Two illustrations to show why the surgeon must move his entire body during excavation of the capsule. **c** Diagrammatic representation of the operation in progress. The bladder is imagined to be transparent. The two *arrows* at the transition from prostatic capsule to membranous urethra indicate the fulcrum around which the resectoscope rotates. The high gear ratio of this lever system is responsible for the extensive movements the operator must execute for small excursions of the cutting loop. **d** Enlarged detail of the prostatic capsule and fulcrum in the region of the membranous urethra

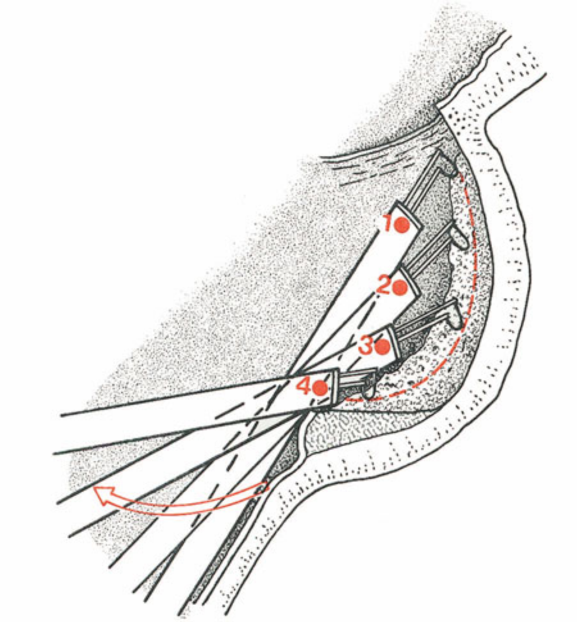


Fig. 160. Excavating the prostatic capsule. Apart from the usual proximodistal movement, this cutting technique demands movements of the loop in an additional dimension, i.e., from medial to lateral and back. The figure shows this procedure exemplified during excavation of the left lateral lobe. The tip of the resectoscope sheath travels distally from point *1–4* but also executes a semicircular movement by abduction of the eyepiece to the opposite side *(dotted line, arrow)*

the fulcrum of the instrument lies in the region of the membranous urethra, so that the shorter lever arm is in the prostatic urethra and the longer one within the penile urethra and outside the patient's body. The surgeon must thus augment his external movements in the ratio of these lever arms so as to achieve adequate excursions at the internal end of the instrument.

The same remarks apply to vertical movements of the operator's head during excavation of the prostatic floor.

Figure 160 provides a visual explanation of these problems: as the sheath glides distally, the loop plunges into the tissue only to withdraw into the sheath at the end of the cut.

To learn this technique of controlled eyepiece excursion is an important aim of training, since it alone permits a rapid time-saving surgical process.

c) Determining the Depth of Cut

Although there are no reliable inherent markers for the depth of cut, two operative maneuvers permit estimation of the tissue volume to be removed, thus promoting complete transurethral prostatectomy without perforation.

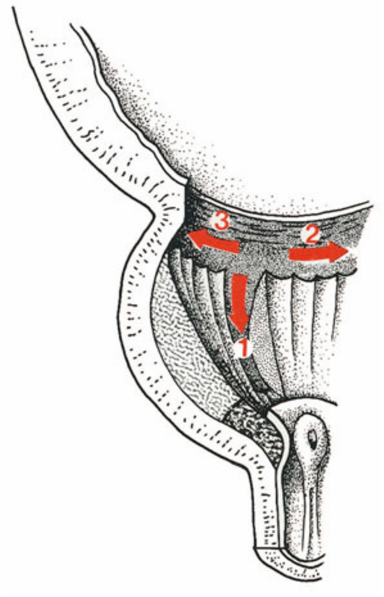


Fig. 161. Excavation technique: Placement of a marker groove (segmental method). Diagram of the right dorsal portion of the prostatic cavity in coronal section. At point *1* the loop has carefully felt its way down to the capsule and thus excavated a groove. The base of this groove provides information on the necessary and possible depth of cut. Such marker grooves are placed on either side at 7 and 5 o-clock. Starting in this groove adenomatous tissue is progressively removed from the entire length of the capsule in a segmental fashion (*2, 3*) (segmental technique)

α) The Trench Method (Segmental Method). In this technique one cautiously "digs" one's way down to the capsule in a series of shallow single cuts, usually in the 7 or 5 o'clock position (Fig. 161). Phase 2 of resection (cone excision) has already exposed the internal sphincter around the entire periphery of the internal meatus. The loop is therefore engaged at this proximal margin and makes a more or less extensive cut, depending on the size of the adenoma. If this reveals further capsular tissue the loop is once again engaged at the capsule-adenoma boundary and a further shallow cut is then carefully made. This process may be repeated until the capsule is exposed along the entire length of the groove. Depending on the bulk of the adenoma, this marking groove will be of a varying depth and ends in the apical region, since the paracollicular tissue cuff is left as a protective barrier until the end of the procedure. The bilateral placement of these trenches at 9 and 3 o'clock indicates how thick a layer of tissue may and must be removed. The two trenches are now extended in both directions until a number of cuts in each segment expose the capsule. Since this technique always exposes the capsule segment by segment, I have termed it the *segmental method.* It may be applied wherever there is a large tissue volume.

β) The Tangential Method. This approach is suitable for adenomas of little substance (Fig. 162). In the previous method, the entire adenoma bulk was

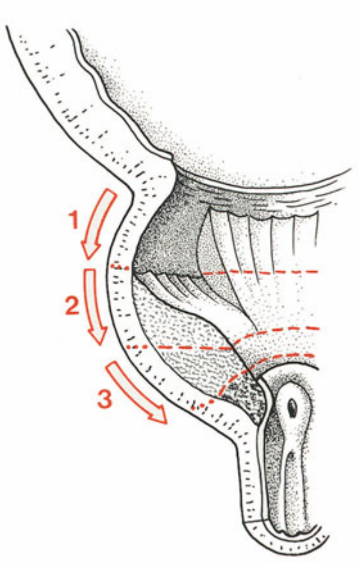


Fig. 162. Excavation technique: Removal of tangential layers (tangential method). Diagram of the right dorsal half of the prostatic cavity in coronal section. Here the capsule is exposed in a series of stages, starting proximally and ending distally at the apex. A short marking groove is cut in the region of the internal sphincter and after exposure of a small area of capsule this groove is then extended laterally until the entire proximal area has been exposed circumferentially (*1*). The process is repeated distally until the apex is reached (*2, 3*). This technique is particularly suitable for small adenomas, where as a rule only two or occasionally three stages are required

divided down to the capsule in a number of radial segments, but here, by way of contrast, resection is carried out in a series of tangential stages. An initial area is cleared in a circular fashion and this field is subsequently extended distally until the entire circumference of the capsule has been cleared down to the apical tissue ring.

Whichever method one employs during this phase of the operation, the landmarks remain the same: internal sphincter, capsule, proximal resection margin.

Once again, resection of apical tissue concludes the procedure, and the technique is the same for all resection strategies.

4. Resecting Endovesical Lateral Lobes

a) Surgical Anatomy

As remarked when discussing the anatomical basis for resection technique, an adenoma may be primarily intracapsular (subtrigonal) or endovesical in its development. The latter endovesical type may present difficulties even to an experienced surgeon, since complete removal of all endovesical portions is often associated with technical and operative problems. The internal sphincter may constrict the adenoma in an hourglass fashion, thus increasing the danger of perforation at the vesicoprostatic junction (see Fig. 83).

b) Resection Technique

If difficulties of this kind are anticipated, they will be best overcome after careful preliminary investigation and examination (cystourethrogram, endoscopic examination, including use of a retrograde telescope) in order to determine whether one is really dealing with this type of adenoma. Endoscopy will indicate at which point there is the least tissue bulk, i.e., at which point anatomical factors have preformed a groove. This may be at the interlateral commissure or at the commissure between lateral and median lobes.

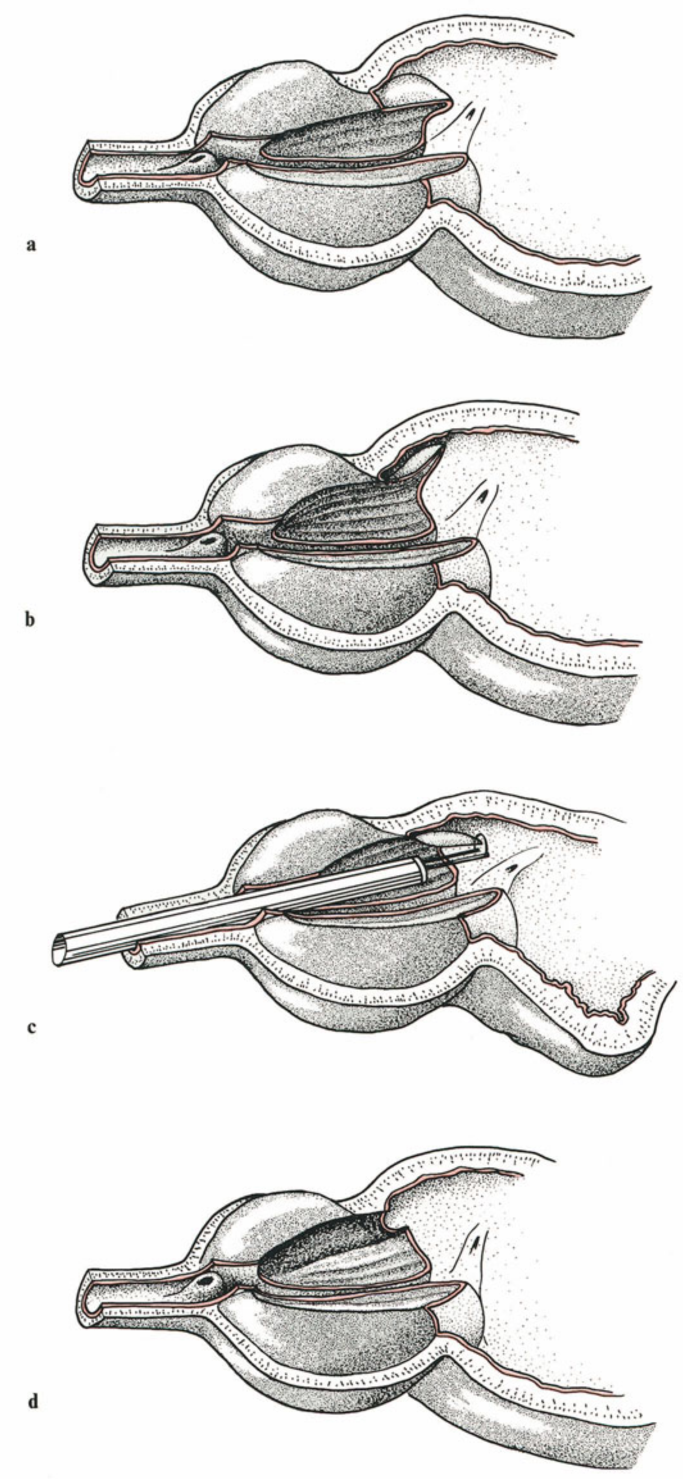
The ventral commissure of the lateral lobes is usually the most suitable starting point. One may once again apply the trench technique previously discussed by laying an ever deeper series of cuts toward the capsule until the internal sphincter is exposed at the transition between bladder on the one hand and endocapsular adenoma on the other (Fig. 163a, b). It may then be that some tissue with the appearance of adenoma will remain proximal to the internal sphincter. This can, however, only be a thin tongue connected to the internal meatus by a narrow isthmus. If a further cut is now made with predetermined starting point, i.e., if the cutting loop is engaged over the tip of this tissue process in an *almost empty* bladder (Fig. 163c), complete separation may be achieved. The resulting state is shown diagrammatically in Fig. 163d.

This final cut greatly simplifies the situation. The internal sphincter is revealed as the proximal limit of resection and the groove allows distal orientation in relation to the capsule. If resection now proceeds with removal of the endovesical tissue down to the internal sphincter, the problem is easily mastered. One must, however, beware of cutting into the endovesical portion in too tangential a fashion, since a thin lip of tissue will then be formed which tends to float away from the cutting loop and present difficulties in further resection. Figure 164 demonstrates this in a diagrammatic way.

Such an occurrence may be particularly unpleasant in ventral areas, since resection of this floating tissue will require very marked depression of the eyepiece before the tissue can be captured. The worst mistake is to separate such a piece of lateral lobe at its base and then be left with a large chunk of tissue that falls into the bladder and is too large to be evacuated.

One aid to resection of a floating lateral lobe residue is to start resection with the bladder almost empty, a marked head-down tilt of the patient and – if the tissue flap lies ventrally – suprapubic counterpressure by an assistant.

Occasionally, it is also helpful to drain the bladder under direct vision through the central stopcock and then review the region with minimum irrigation flow. The residual tag of adenoma is found hanging into the lumen of the prostatic cavity and is easily grasped.


a
b
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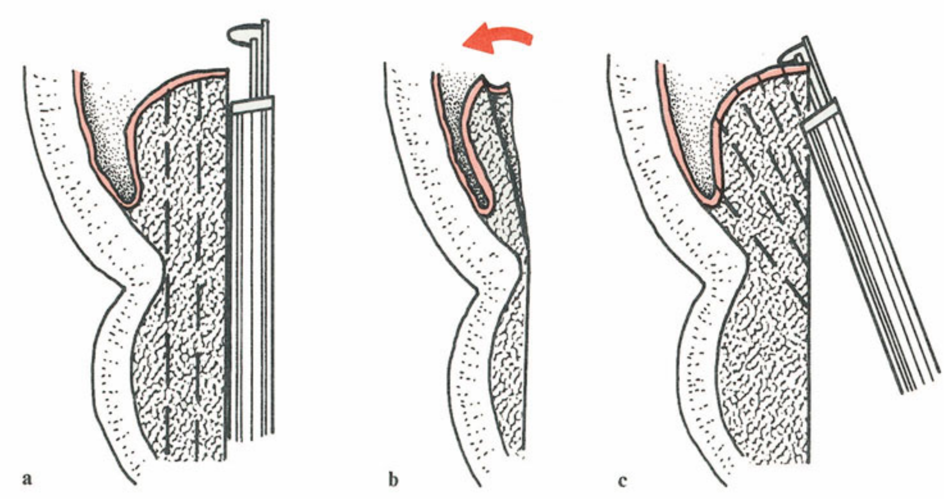

Fig. 164a–c. Diagrammatic section through an endovesical lateral lobe at the transition bladder-prostate. Avoidance of the problem described in Fig. 163a–d. **a** The lobe is being resected in shallow tangential slices. **b** Formation of a floating lip of lateral lobe process. This is difficult to resect without dividing it at the base and leaving a large free fragment floating in the bladder. **c** If steeper slices are taken from this lobe by increased abduction of the instrument, this problem may be avoided (similar procedure for resection of endovesical median lobes)

5. Resecting Endovesical Median Lobes

a) Surgical Anatomy

The situation is similar to that appertaining to endovesical lateral lobes. A more or less developed median lobe bulges up into the bladder and may even reach beyond the interureteric bar. There is thus a danger of injury to the ureteric orifices. If, on the other hand, the retroprostatic recess is deep, the median lobe will lie free within the bladder without contacting the bladder base. A very narrow internal sphincter may once again constrict the lobe near its origin (see Fig. 83).

◁ **Fig. 163a–d. Resecting an adenoma with endovesical extension.** Coronal section through bladder and prostatic cavity. The adenoma has been left protruding above the plane of section. **a** The first few cuts have been made into the lateral lobes. This results in the endovesical portion of the lateral lobe becoming somewhat attenuated and less resistant at its base. **b** Excessive excavation of the lateral lobe from its urethral aspect will render it ever thinner. It thus escapes attempts at ablation and is difficult to grap with the loop. **c** This situation corrected by cutting with an empty bladder. The collapsed bladder presses the lateral lobe down toward the loop as long as the irrigating flow is reduced. It may be necessary to repeat this maneuver as described in the text until the entire floating lobe remnant has been ablated (cut with predetermined end point!). **d** Arrangement after this error has been corrected. All endovesical tissue, including the residual lip of the lobe, has been removed. For avoidance of this problem see Fig. 164

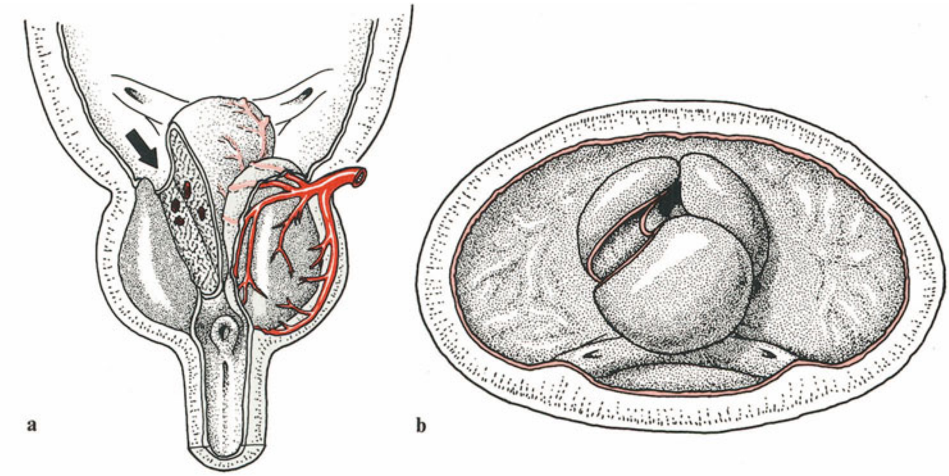

Fig. 165a, b. Blood supply of the median lobe and resection technique. Coronal section through the distal bladder and prostatic cavity. **a** On the left side of the patient (*right side* in the illustration) the blood supply is shown as described by Flocks (1937, 1945). A branch of the urethral artery penetrates the lateral lobe and supplies the median lobe. On the *left* of the figure, a groove has been cut between median and lateral lobes (*arrow*), thus interrupting the supply to the median lobe. If such a groove is cut on either side and the vessels then coagulated, further tissue removal will lead to little hemorrhage. **b** Same situation, seen from the bladder. Note the groove cut between lateral and median lobes

b) Resection Technique

The trench principle may again be employed. In the junctional region to the lateral lobes there is usually a substantially reduced amount of tissue so that a few radial cuts in this region, directed toward the capsule, will expose fibers of the internal sphincter. No tissue should be left proximal to the internal sphincter, just as when resecting endovesical lateral lobes. A similar cut is placed on the opposite side, since its purpose is not only provision of landmarks but also partial devascularization of the median lobe (Fig. 165). After coagulation of the often sizeable vessels transected, removal of the median lobe may commence. Careful attention should be paid to avoiding shallow tangential incisions, since the same problem may otherwise arise as described for lateral lobe resection (Fig. 166, see also Fig. 164).

I have found it best always to begin at that point which offers optimal orientation, i.e., in the grooves either side of the median lobe. Illustrations 24 (Plate IV) and 25 (Plate V) illustrate initial phases in the cutting of this groove.

The ureteric orifices should be protected by the technique of predetermined starting point, since a tangentially resected median lobe may sink onto the base of the bladder and lie across the orifices.

Again, there is a possibility of producing a large free fragment by injudicious division of the lobe remnant, and this may present difficulties in evacuation.

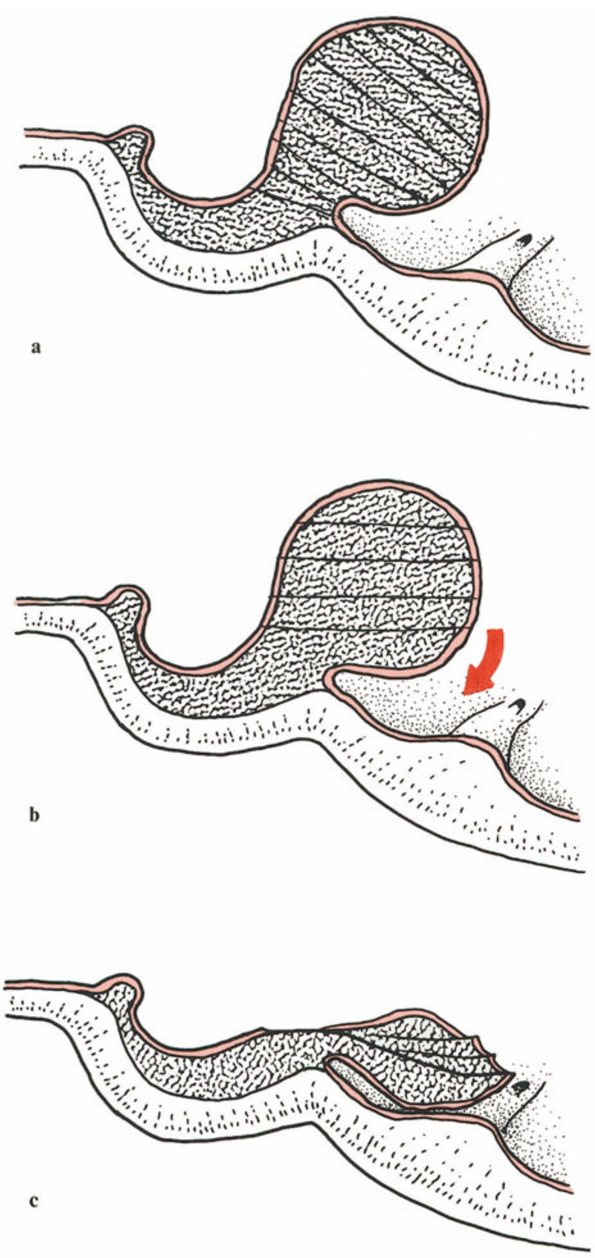

Fig. 166a–c. Technique of median lobe resection. Diagrammatic sagittal section. **a** Correct technique of resection. The slices are of increasing steepness (eyepiece raised), so as to avoid formation of a residual lip. This is particularly important to prevent the lobe remnant lying across the interureteric bar, which later would be endangered by further cuts. **b** Shallow resection of the median lobe results in the formation of a tongue. **c** End stage of this erroneous technique. Solution: the lobe is grasped and cut with a predetermined starting point; lift up the lobe with cutting current off; cut only when loop and lobe tissue are clear of the ureteric field

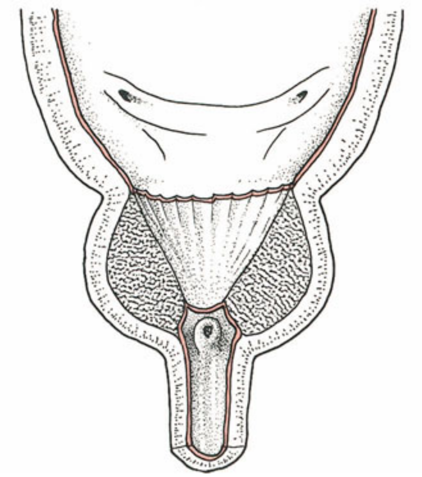

Fig. 167. Final arrangement after ablation of endovesical median lobe. Coronal section through the distal bladder and prostatic cavity. As the median lobe is ablated each cut is continued down into the interior of the prostatic capsule. The base of each lateral lobe is thus removed as in the technique previously described (Figs. 133–138, especially Fig. 136)

Once the entire circumference of the internal sphincter has been exposed and the distal margin of resection has been defined, this phase of operation may be regarded as over. Figure 167 represents this state.

6. Barnes' Method

a) Preliminary Considerations

Barnes described his method of resection in a monograph in 1943, the very year of Nesbit's publication. In fact the procedure we nowadays regard as Barnes' method was not described in detail until 1959, although its basic principles had been set out in *Endoscopic Prostatic Surgery*.

The method is distinguished from Nesbit's by the way it adapts strategy to the configuration of the adenoma. Whereas Nesbit concentrated his technique on early circumferential exposure of the internal sphincter, Barnes aims to completely clear one side after the other. Nevertheless, the three main phases of proximal, middle and apical resection are once again easily recognizable (Fig. 168).

b) Resection on the Prostatic Floor

The floor of the prostatic cavity is first of all cleared, together with the median lobe (Fig. 169a). Barnes favors ablation of tissue in layers (Barnes 1959) rather than laying out marking grooves.

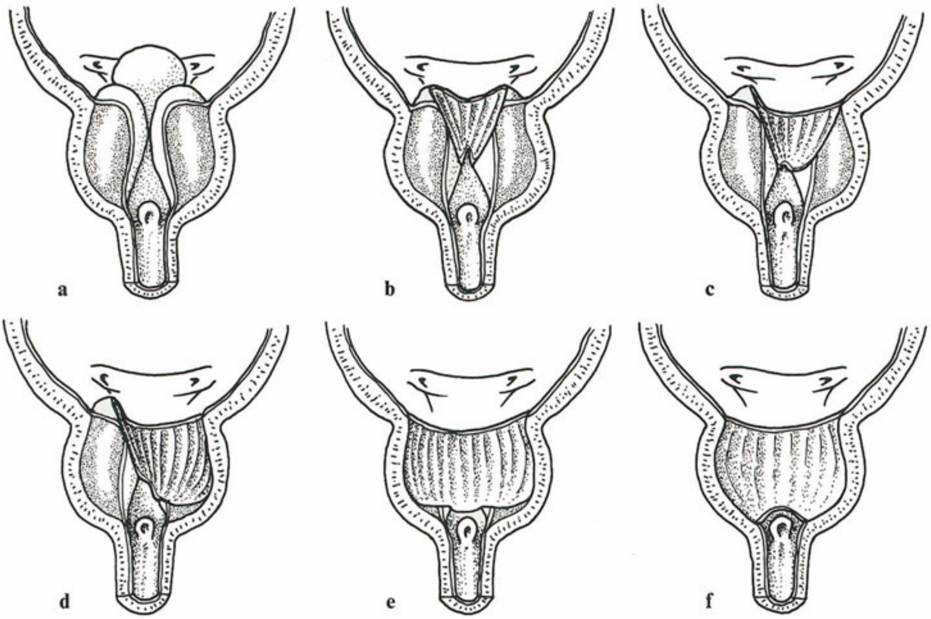

Fig. 168a–f. Stages in the resection method of Barnes. Coronal section through the lower urinary tract: bladder – prostate. **a** Arrangement prior to operation. **b** Excision of median lobe and basal portions of lateral lobes. **c** Further ablation of the endovesical part of the median and of the left lateral lobe, together with the endourethral part of both. **d** Complete excision of the left lateral lobe except for an apical remnant. **e** Same procedure on the right-hand side. Only apical tissue now remains on either side. **f** Final arrangement after completion of resection. (After BARNES 1959)

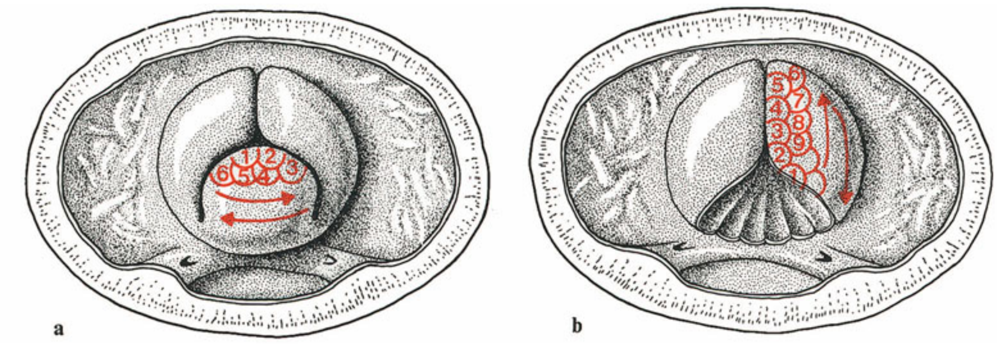

Fig. 169a, b. Resection plan for median (a) and lateral (b) lobes. Cross section through the bladder slightly above the ureteric orifices. (After BARNES 1959)

c) Lateral Lobe Resection

A tissue cone is first removed from *one* lateral lobe (Fig. 169b). Tissue is once again removed in layers, this time in a vertical direction. Starting on the floor of the cavity, where excision of the median lobe will already have provided some landmarks, one lateral lobe is now ablated, working from dorsal to ventral away from the prostatic floor. An initial attack is made on the medial surface of the lateral lobe within the flattened scabbard-like lumen of the urethra. This requires axial rotation of the instrument if ventral portions of the lateral lobe are to be reached. The procedure is only subdivided to the extent that a proximal half cone, i.e., the endovesical and medial intracapsular part of one lateral lobe is first excised, and this is extended by a second cutting series to include the endourethral region. Only when the entire lateral lobe has been removed does BARNES approach the opposite side. Neither in the 1943 publication nor in the 1959 manual is the technique of apical resection expressly described.

d) Conclusion

The principal characteristic of BARNES' technique is certainly the recommendation of a dorsal starting point. He never described his method in the same detail as did NESBIT, but despite this sparsity of instructions one may nevertheless easily imitate his technique. It was perhaps his description and illustration of layer-by-layer tissue removal that made the greatest contribution to resection techniques in general. His systematic approach is an excellent source of working principles, even if there are other reasons for not following his general method. In particular, the idea of complete initial removal of one lateral lobe has been taken up by MARBERGER (1965, personal communication) and his school. They particularly favor this approach for the resection of large adenomas which, on general considerations, they prefer to excise in two separate sittings. In addition to this, the procedure has the further advantage that it is easily terminated at any time if some operative problem should so require (venous sinus, perforation, circulatory problems). I personally prefer a bilateral approach in which a stage of resection is carried out first on one side and then repeated on the other. I have little personal experience of BARNES' resection as a whole, although the step of median lobe ablation is entirely derived from him.

7. The Method of Alcock and Flocks

a) Preliminary Considerations

The technique of ALCOCK and FLOCKS most closely resembles our own, differing only in the approach to resection of the lower lateral lobe. The trenching out employed by both authors to subdivide the median lobe at its midpoint, i.e., at approximately 3 and 9 o'clock is employed by us whenever a larger adenoma is to be removed. Under these circumstances one may indeed provide several such grooves and then remove the tissue in individual portions. I was fortunate enough to watch FLOCKS' own mastery of this technique in Iowa City in 1951, prior to its detailed publication in his *Surgical Urology* (1954).

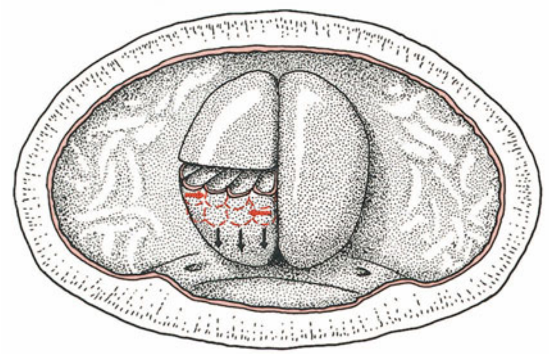

Fig. 170. Resection method of Alcock and Flocks. Cross section through the bladder slightly above the ureteric orifices. The left lateral lobe has been divided from the 9 o'clock position at its equator and at right angles to the capsule by a trench cut. Tissue is subsequently removed down to the floor of the prostatic cavity in a series of horizontal slices. The procedure then continues with an identical approach on the opposite side

b) Removing the Median Lobe

The procedure begins in a similar fashion to that of BARNES with removal of the median lobe, except that this starts laterally. A groove is incised on either side at the junction of lower lateral lobe and median lobe, and extended to such a depth as to expose fibers of the internal sphincter and divide the principal vessels feeding the median lobe (see Fig. 165). The entire median lobe may then be ablated down to the internal sphincter fibers. In fact this series of cuts on the floor of the prostatic cavity always removes a portion of the lower end of the lateral lobes, thus leading naturally to the next phase of operation.

c) Removing the Lateral Lobes

This is a highly original feature of the technique, since the lateral lobes are now first divided at their midpoint in the 3 and 9 o'clock region by a radial trench (Fig. 170). This trench runs laterally from the urethral cleft toward the capsule until fibers of the internal sphincter are encountered. The tissue to be removed has thus been marked or encircled. The operative limits are then determined by these marking grooves. Whether the lateral lobes are now resected from median to lateral according to the BARNES' technique, or by the resection of horizontal tissue layers according to NESBIT'S will depend entirely on the local situation. Voluminous lateral lobes projecting far into the urethral lumen will present such a tissue bulk that layers may simply be removed in a horizontal fashion. For less bulky glands, a technique of resecting progressively from medial to lateral is recommended. As in all the other methods, there is scope for many personal variations.

Advantages. The advantage of this technique is the way it simplifies the entire procedure. Once the lateral lobe has been divided by a marker trench it is able to sink toward the floor of the prostatic cavity, and in this position it is accessible to a series of horizontal cutting sequences by which it may be progressively removed. All this work may be carried out in a normal position and with the resectoscope held in the usual way. It is therefore far less tiring than working in a contorted posture.

d) Removing the Ventral Tissue

This is carried out as previously described (see p. 201), although voluminous glands may render this phase of operation quite difficult since the volume of tissue to be removed may be substantial. The technique I described at the outset of "encircling" the ventral tissue from either side and then finally resecting what is left between 11 and 1 o'clock is heartily recommended. Previous resection of the region between 9 and 11 or 3 and 1 o'clock will leave the ventral midline residue hanging freely in a dorsal direction within the urethral lumen, whence it is easily removed.

e) Resecting the Prostatic Apex

Rectal support and tilting the resectoscope beak down into the prostatic cavity are both to be recommended. In cases where the adenoma has extended beyond the verumontanum, it is imperative to identify the external sphincter, whose structures may be recognized under the mucosa by withdrawing and advancing the instrument. All the various aids previously described for this phase of operation may be applied without difficulty to the present technique.

f) Conclusion

An extremely mature resection technique has just been described, based on the principle of dividing adenoma tissue into individual, carefully defined and delimited portions, to be ablated individually. This idea has much to recommend it, particularly to the beginner who will thus find himself working within a clearly limited area devoid of orientation problems. Our own method is based on this procedure, with the single difference that we prefer resection of the basal lateral lobes to proceed from below upward.

Resection from above downward presents a difficulty to the inexperienced, since it requires a marker groove to be laid whose proximal limit is not easy to establish.

The above technique is, however, considerably easier to learn than the NESBIT procedure. In the operative surgery courses held in our clinic we present the method of ALCOCK and FLOCKS as the standard technique to be employed in larger adenomas.

8. Final Inspection at the End of Operation

This section is concerned solely with morphologic aspects of resection, not with the question of hemostasis. The latter is naturally one of the most important features of the final inspection, but for methodologic reasons it is discussed separately.

a) Inspection of the Bladder

Since the field of resection is in continuity with the bladder, only separated from it by the internal sphincter, the bladder has absolutely to be included in any final inspection. Not only should accidental injury be looked for. It must also be ensured that resection material has been completely evacuated.

α) Looking for Injuries. Trauma to the bladder, especially to the trigonal area, is a potential complication. In fact we have hardly ever come across it, since it is easily avoided by proper technique and is only likely to arise where surgery is carried out with inadequate visibility or absence of clear orientation.

The trigone and ureteric orifices are particularly at risk in the presence of a median lobe which projects into the bladder. The situation is easily understood if the internal sphincter is carefully inspected with a 0° telescope (resection telescope), when it will be immediately apparent whether one or more cuts have passed proximal to this boundary. The bladder base and ureteric field also warrant careful inspection. Injuries may be easily recognized by an absence of mucosa and the visibility of bladder wall musculature.

β) Looking for Retained Resection Chips and Coagula. This inspection is of the greatest significance for the postoperative course, since resection chips left in the bladder may subsequently block the catheter. Blood clots may have a similar effect and therefore need to be carefully evacuated.

In most cases this final inspection is merely a routine safety procedure, since our use of a resectoscope provided with a drain port leads to more or less automatic evacuation of most resection debris. In cases of true or pseudodiverticulum, however, considerable importance attaches to ensuring that no chips are left in depressions and sacculations. Such chips, it is true, are less likely to cause a postoperative catheter blockage but they may nevertheless lead to serious urinary infections and subsequently become encrusted or act as a nidus for secondary calculus formation. The base of the bladder, where resection chips are usually found, should be inspected under minimal irrigation, since the fragments will otherwise be washed out of the field of view.

γ) The Large Free Fragment. During resection of endovesically protuberant median or lateral lobes a large tissue fragment is occasionally separated at its base so as to fall into the bladder. These pieces are far too large to be aspirated through the resectoscope sheath. However hard one tries to avoid this tiresome problem it still occurs from time to time.

Recognizing the free fragment. Whenever there are sudden jerky interruptions to the free drainage of irrigating fluid during an operation the suspicion of a large free fragment will arise. All attempts to correct the problem by vigorous evacuation will fail.

The diagnosis must finally be made endoscopically. The bladder is first of all drained. This is usually achieved by directing the sheath aperture toward the vault or by sweeping movements across the base of the bladder.

Instruments with a central stopcock permit drainage under direct vision and the presence of the electrotome within the sheath will then prevent the fragment from lying across the aperture.

Extracting the fragment. Three methods are available:

1. Extraction by lithotrite or foreign body forceps. This used to be the standard method in the days before improved cutting current became available and permitted comminution of the fragment within the bladder. It is always surprising how large a fragment will pass the urethra without any force being employed. They are easily deformed and adapt to the cross section of the urethra so that little or no mucosal damage results. It goes without saying that the use of force is absolutely contraindicated. The fragment must be firmly engaged in the forceps, since for it to slip out in the urethra will give rise to new and unpleasant difficulties.

2. Comminution of the fragment within the bladder or prostatic cavity. This is the method nowadays in general use and is rendered unproblematic by the excellent cutting power of modern diathermy current. One or two tricks facilitate the procedure. The fragment must first be found and then grasped by engaging it between cutting loop and sheath aperture. It is often difficult to localize within the bladder, only sinking to the bottom when the irrigating flow is reduced to an absolute minimum.

Once the fragment has been grasped it may be cut up either within the bladder itself, on the floor of the bladder or within the prostatic cavity. The first step is for the underside of the tip of the sheath to press it against the floor of the bladder or prostatic cavity (electrical contact!). Once it has been fixed in this way the loop is cautiously extended beyond the fragment, lowered and retracted so as to cut off a small piece. With luck the main fragment will remain fixed under the sheath, otherwise it must be found once more. Depending on the size of the initial fragment a number of cuts, normally between five and ten, will be necessary for complete extraction.

3. If the free fragment is somewhat smaller, but nevertheless too large to be evacuated through the sheath, it may be extracted by firmly wedging it between aperture and loop and then withdrawing the whole instrument complete with fragment. This procedure is somewhat more risky, since the tissue fragment may slip out and be lost within the urethra. I only employ this third technique if the fragment is quite small and I am certain that the bladder is otherwise entirely empty, thus obviating the need to reintroduce the instrument.

I usually prefer to cut these pieces of tissue up within the prostatic cavity – if this is already well excavated – since this is the easiest place to hold the fragment still.

Care should be taken to avoid accidental injury to the bladder base or prostatic capsule (no blind cutting!).

The procedure is concluded by a final inspection to ensure that all fragments have been removed.

b) Inspecting the Cavity for Complete Clearance of Tissue

This procedure really forms part of apical resection, but it is nevertheless imperative to repeat it before removing the instrument. One of two methods may be employed: scanning the cavity wall or inspection of the paracollicular tissue.

α) Scanning the Cavity Wall. The instrument is briefly advanced beyond the verumontanum toward the bladder. Under good conditions the entire field of resection can be scanned in radial sectors. If the adenoma was small (bladder neck 2–3 cm long), this may be possible in a single view, since the field can be inspected with adequate depth of focus and magnification. Only a weak irrigating flow should be employed so as to reveal bleeding points. The closer the telescope approaches the tissue, the better the view of fine detail. This is not, however, the aim of this inspection which is mainly concerned with the final degree of smoothness in the field of resection. Small tissue tags and ridges between individual cuts are smoothed off. Occasionally, small islands of adenoma tissue will be seen protruding into the lumen. This is also the best time for detecting injuries to the capsule and venous sinuses, and the inspection goes hand in hand with final hemostasis as discussed elsewhere.

β) Inspection of Paracollicular Tissue. The further one withdraws the sheath into the membranous urethra, the more the bladder neck tissues will assume their final configuration. Because of its fibromuscular constitution the prostatic capsule has the ability and a tendency to retract.

This may result in residual adenoma tissue swinging into the urethral lumen. Furthermore, this position of the instrument may enable tissues previously prevented by the sheath from fully expanding to move more freely and take up a configuration in which they are more easily visible. Denis (1959) has given a good description of this situation, terming a lateral lobe incised at its base so as to sink dorsally when the instrument is withdrawn "lobe phantôme" (Fig. 171). By the same token, any other part of an incompletely resected adenoma will assume its preferred position once the sheath is withdrawn to the observation point (Mauermayer 1962). They ususally hang down from ventral to dorsal, unless the sheath had previously pressed them down when they will spring up into the urethral lumen. This behavior is particularly likely if a long beaked sheath is employed, since its projection into the cavity may so displace adenoma tissue as to render it quite invisible. With the sheath withdrawn to the observation point, the tissue is able to return to its normal place and then becomes freely visible.

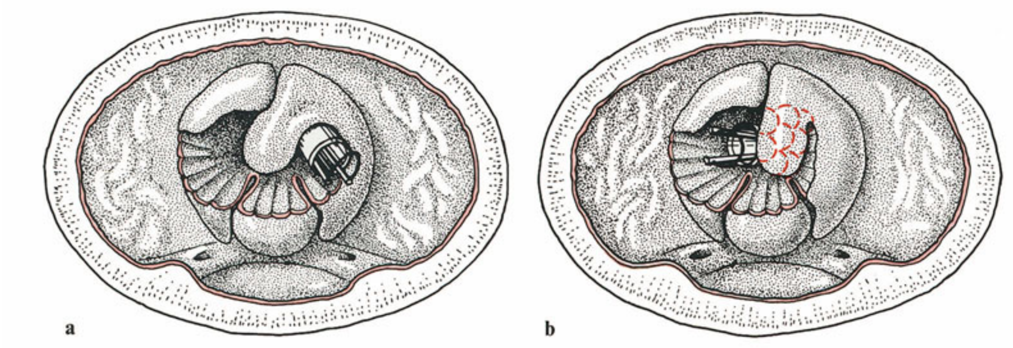

Fig. 171 a, b. Correcting an inadequate resection by retracting the sheath to the urethral observation point. Diagrammatic cross section through the bladder slightly above the ureteric orifices, looking toward the urethra. **a** The resectoscope sheath presses the poorly resected lateral lobe upward. The surgeon thus believes himself to be at the 12 o'clock position. **b** After retracting the sheath to the observation point the "lobe phantôme" (DENIS 1959) swings back into its resting position and may then be correctly resected from lateral to medial. In the example shown here, the floor of the cavity remains to be cleaned and the cavity excavated

V. Resecting Outsize Adenomas

1. Preliminary Considerations

Although the elements of cutting technique are the same as for small adenomas, a variety of points should be borne in mind:

1. Only those whose operating technique is so mature that they can remove 3 g per minute during the initital phases should attempt resection of adenomas greater than 70–80 g.
2. Careful consideration should be given to the relative indications for transurethral or enucleative adenomectomy.
3. Although we generally tend to manage our resections without blood transfusion, all the necessary preparations should be made.
4. Internal urethrotomy is mandatory for these cases, even if instrumentation is easy. The stricture rate is directly related to the quantity of tissue to be removed. Resection via a perineal urethrotomy may even by considered.
5. We think it unnecessary to use wide-bore resectoscopes, since we remove *all* large adenomas with a 24-Ch sheath in the same length of time as previously with a 28-Ch instrument.
6. The patient should be warned that, under certain circumstances, operative conditions may require the procedure to be completed at a second session.

2. Points of General Technique

a) Tissue Volume per Cutting Run

In order to remove large volumes of tissue with each filling of the bladder, one must work rapidly and accurately. Thanks to the excellent irrigating power of modern resectoscopes a low rate of flow will be quite adequate for a normal degree of hemorrhage. This may be achieved either by lowering the irrigator or, alternatively, by using the stopcock to control the rate of flow. I prefer the latter method, since full pressure then remains available for initial clearance. After a few seconds – when optimum visibility has been achieved – I reduce the rate of flow so that I can just see. A normal bladder capacity of 250–350 ml will then permit 10–15 cuts to be executed, depending on their length.

b) Rapid Evacuation of Irrigating Fluid and Chips

Our resectoscope sheaths are equipped with a drain port to which a rubber bulb may be connected for evacuation purposes. This permits extraction of large volumes of resection material without blockage of the drain system (Fig. 109). Evacuation is thus achieved in a considerably shorter time with a consequent improvement of the gram/minute relationship for the whole resection. In rare cases where a large quantity of chips nonetheless block the drainage path the system may be cleared by attaching an aspirating syringe to the sheath.

3. Trocar Drainage

Twenty years ago we were already resecting patients who had a suprapubic catheter (e.g., for overflow incontinence). We have remained unconvinced of the technique since the prostatic cavity cannot then be assessed by the usual interplay of bladder filling and emptying. In recent times, REUTER (1980) has revived suprapubic drainage, as previously advocated by TRUSS (1968).

For reasons already stated we do not employ this technique (see p. 148), and we decline to use this route of continuous evacuation, even in patients who have a suprapubic catheter before surgery.

4. Resection According to Iglesias

Unfortunately we have not found this technique useful for large resections. The evacuation slits rapidly become blocked by tissue fragments and blood clots. Visibility deteriorates after only 15–20 min. Furthermore, resection chips accumulate in the prostatic cavity, particularly if the retroprostatic recess is shallow. In the light of our experience, therefore, we cannot recommend the use of this instrument for particularly large adenomas.

5. The 'Rasp' Technique of Reuter

Although Reuter mentions this method in his 1963 monograph, no further description is given. For the removal of large expanses of tissue he cuts continuously in a forward, and backward direction with cutting current continuously on. To my knowledge he has no followers in this respect.

6. Subdividing the Field into Cutting Zones

The maintenance of careful orientation is a prerequisite for successful endoscopic surgery in a very extensive field. A considerable reduction in workload may be achieved by carefully subdividing the field of resection into individual zones. Only when one zone has been completely cleared is a further one approached. Such systematic subdivision of large fields into individual parcels also considerably improves orientation.

7. Marking Trenches

By the suitable placement of grooves, a volume of tissue may be subdivided into smaller portions. Marker grooves may thus expose the tissue limits (internal sphincter, capsule, distal resection limit), providing a starting point for each successive cutting series.

8. Optimal Hemostasis

The technique of resection should be directed toward immediate hemostasis. We have found a good solution to this problem in the cutting of marking grooves and in starting at the capsular margin (see presentation of our own technique, p. 248). Under no circumstances should hemostasis be relegated to second place simply to accelerate the removal of tissue and only to be carried out when this is completed.

9. Determination of Blood Loss

Whenever one 10-l bucket has been filled with irrigating fluid, the running blood loss should be determined. Although the method of NESBIT and CONGER (1963) is still in use in the USA, its inaccuracy in the face of large blood volumes is quite unacceptable (HARTUNG et al. 1976).

The anesthetist must be informed of the blood loss as soon as it is known. This requires an *accurate* method suitable for use in the operating room itself and taking account of the patient's own preoperative hemoglobin value.

10. Encumbrance of the Surgeon

Teaching attachments should only be used by very experienced surgeons when operating on large glands, since some degree of encumbrance is unavoidable.

11. Nesbit Technique

In his 1943 monograph NESBIT devotes several pages to the massive intracapsular adenoma.

His method consists of subdividing adenoma tissue by concentric circles, first of all circumcising a more central tissue cone around the urethra and then ablating it from ventral to dorsal. This maneuver is repeated two or three times until all tissue has been removed to the level of the urethral floor (Fig. 172).

This dorsal tissue bulk is then undercut on either side and resected in the usual fashion. Illustrations describe the technique better than words.

I have often attempted to imitate this technique without ever finding it to have substantial advantages. Its chief disadvantage, compared to NESBIT'S

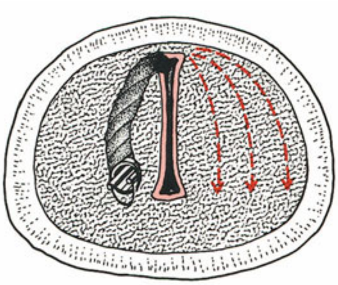

Fig. 172. Resection of an outsize adenoma after NESBIT. A series of trenching cuts deprive the adenoma of its blood supply. Once each area of tissue has been encircled and resected, a further encircling trench is cut more laterally. (After NESBIT 1943)

basic method, lies in the loss of his original brilliant concept of *first* dividing vessels along the capsule. Certainly one area of tissue is devascularized (after circumcision) after another, but the process of dividing and coagulating vessels needs to be repeated two or three times, depending on the number of trenches.

12. Our Own Method

Our own technique for the resection of outsize adenomas is now to be described. We employ it wherever more than 50 g of hyperplastic tissue is to be removed (Fig. 173). The procedure derives from the trenching cut of Alcock and Flocks.

a) Phase 1

α) Step 1. A marker groove is first cut at 6 o'clock and all endovesical median lobe tissue is removed as already described. This phase will also expose capsule in the dorsal area, although a wider groove is naturally required for this. The initial creation of broad working surfaces is a general principle in the resection of outsize adenomas, since it permits free drainage of irrigating fluid and the easy transfer of resection chips into the bladder cavity. This principle is analogous to the technique of Alcock and Flocks already described.

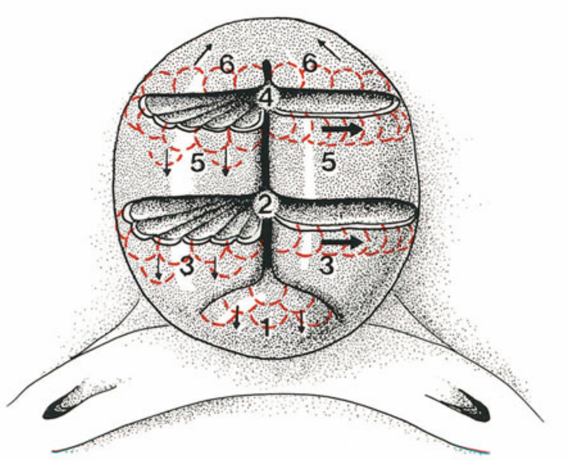

Fig. 173. Resecting an outsize adenoma (our own technique). By analogy to the method of Alcock and Flocks the adenoma is subdivided into a series of "storeys." This is not difficult to accomplish employing the previously described technique of horizontal trench cuts. The tissue thus encircled can subsequently be resected with an entirely acceptable blood loss. Advantages of this procedure: subdivision of the operation into a number of easily manageable stages and maintenance of full orientation. *Left,* the direction of further resection for complete tissue removal is shown (*small arrows*); on the *right* the direction of trenching cuts is indicated (*large arrows*). *1–6:* Sequence of individual stages

β) Step 2. Wherever there is marked lateral lobe development the prostatic urethra will be extensively flattened and broadened in the dorsiventral plane. Depending on the apparent 'height' of the urethral cleft the lateral lobes are now subdivided into two or more portions by marking trenches. This principle has also already been described and is applied to the resection of large volumes of hyperplastic tissue in the following way: radial cuts are placed from the urethra toward the capsule until sphincter fibers appear at the internal meatus. The first trench should be fairly dorsal to be followed by more ventral ones as the operation proceeds, until only a ventral tissue block remains. The trench has three purposes:

1. A large tissue bulk is subdivided into individual parcels.
2. By first dissecting out the floor of the cavity one allows the lobe to drop in a dorsal direction. The tissue may thus be removed plane by plane in a series of horizontal cutting runs, the instrument being held in the usual fashion.
3. The first few cuts of each plane along the capsule expose vessels entering the adenoma, and these may then immediately be coagulated. Always start laterally!

Here, as already described in the technique for resecting small adenomas, I like to maintain a symmetrical procedure. As soon as one step has been completed it is repeated on the opposite side.

γ) Step 3. Depending on the size of the gland the procedure of Step 2 is repeated once or twice. The technique is always the same: a trench is cut down to the capsule and the tissue then removed, with the modification that in more ventral regions tissue may be removed from medial to lateral and it is no longer necessary to maintain a horizontal cutting plane ("vertical plane"), the reason being that I have occasionally separated entire fragments of lateral lobe in toto so that these then fell into the bladder. As everyone knows, such fragments are difficult to extract (see p. 156, 241).

δ) Step 4. The resection of ventral tissue concludes this phase of the procedure, the main tissue bulk now having been removed.

b) Phase 2

The capsule is now excavated by the extended cutting technique until only apical tissue remains. This is achieved by radial cutting, starting ventrally (although one might equally start dorsally) and dissecting out the cavity in its entire circumference cut by cut. It is for this phase that the expression "teaspooning" was coined as an accurate description of the procedure.

Total mastery of extended cutting technique is an absolute prerequisite if reasonable amounts of tissue are to be removed in a short time. Because starting and end point are already clearly visible this should be quite simple. Whoever is able to complement simple proximo-distal cutting with lateral (or dorsiventral as appropriate) excursions so as to follow the curvature of the capsule will gain considerable time ("submerging" the loop).

c) Phase 3

Once again, Phase 3, resection of apical tissue, concludes the operation. This is exactly the same as for small adenomas, except that here the urethral cleft is longer than usual. The paracollicular region has exactly the same appearance as in smaller glands, being curved and lying around the verumontanum in an arch.

13. Conclusion

The resection of outsize adenomas has not been presented in this degree of detail solely to encourage urologists in the transurethral removal of such glands. The intention was simply to give those surgeons whose own operative technique has matured to a point permitting such extensive transurethral surgery without hazard to the patient the benefit of my own experience. I cannot pretend that an adenoma is not occasionally approached transurethrally that, from its size alone, would perhaps better have been removed by enucleation. This is usually the result of incorrect preoperative assessment. The remarks in the present chapter may be equally helpful in such cases.

Statistics from our own clinic show clearly that even our younger colleagues are capable of removing quite large adenomas in a reasonable time, i.e., within an hour, and with an acceptable blood loss, if they are properly trained.

It should also have become clear that the resection of large adenomas is a systematic procedure which can be taught and learnt just like that for small glands.

Chapter F
Hemostatic Technique

I. Blood Loss During Transurethral Prostatic Surgery

1. Preliminary Considerations

I wish to begin this chapter with some remarks on the estimation of blood loss, since it is a matter of experience that all surgeons tend to *underestimate* the blood loss during operations they perform themselves. This danger arises particularly whenever the surgeon cannot himself inspect the drained irrigating fluid, as is the case in any resection employing either the Iglesias method, trocar drainage or our own evacuation port on the sheath. There are good psychologic reasons for this. The surgeon concentrates on achieving the best possible tissue clearance, and particularly in large glands, he often has to work against time. As a result of bad habits or bad training, hemostasis is not undertaken until visibility deteriorates. It is one aim of this chapter to expose the fallacy of approach. However that may be such an accurate method of estimation is indispensable if one is to know the actual loss.

We suggested as the subject of a doctoral thesis that the various published methods of blood loss estimation be reproduced and compared one to another. The accuracy of estimation was tested simply by comparison to a standard. This was prepared by diluting blood of known hemoglobin concentration with a known volume of the irrigating fluid routinely used for transurethral surgery. Most methods proved to have extremely wide margins of error.

Thus the method of NESBIT and CONGER (1941) *gave far too low values* as soon as the blood loss rose substantially. We thus encouraged the development of a blood loss estimator based on the particularly reliable cyanohemoglobin principle. The instrument was to be simple and reliable, occupy little space and have a facility for calibration with the patient's own preoperative hemoglobin concentration. The design of such an instrument was published in 1976 (HARTUNG et al. 1976). Since then we have used it routinely for the measurement of blood loss during all transurethral operations. As a result, a variety of interesting data emerged, e.g., a relationship between excision weight and blood loss, as well as a 'personal touch' of each individual surgeon in our clinic.

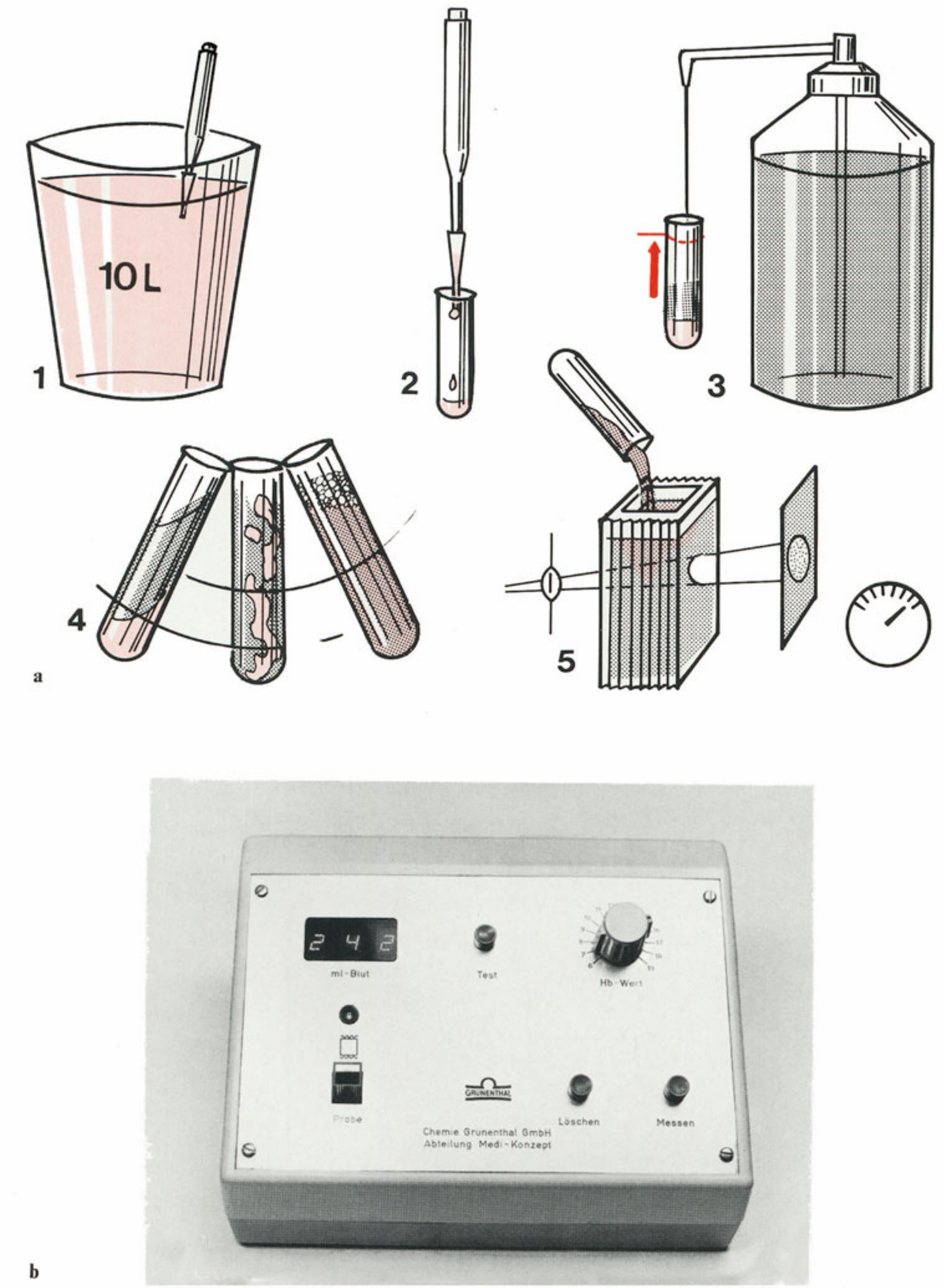
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Fig. 174a, b. Blood loss determination. a Diagram of the method. *1* Aliquot taken from the collecting bucket as soon as 10 l of irrigating fluid have accumulated (1-ml micropipette); *2* irrigating fluid pipetted into a test tube; *3* addition of 9 ml cyanide reagent by autopipette from a stock solution; *4* mixing of irrigating fluid and reagent; *5* introduction of sample into measuring chamber. **b** The instrument used in our clinic

2. A Method for Blood Loss Estimation

During open surgical procedures, blood loss is usually estimated by measuring the sucker volume and weighing wound swabs. Such a rough estimate is not available during transurethral surgery if irrigating fluid is allowed to drain away unmeasured.

Drained irrigating fluid must therefore be collected. In units where an assistant holds a receiver under the outlet of the resectoscope sheath, these receivers must be emptied into a collection bucket. A stainless steel pail marked 1–10 in liters is very suitable. Our own estimation apparatus is geared to this 10 l volume. In addition we have had our bucket fitted with a drainage cock to allow its rapid emptying down the floor gulley each time the 10-l mark is reached.

As soon as 10 l of irrigating fluid have been used, an aliquot is collected from the bucket and blood loss determined with our special apparatus (Fig. 174).

Preliminary experiments have shown that in the wake of substantial hemorrhage, blood may coagulate despite dilution with irrigating fluid. For this reason we add 100 g sodium citrate to the bucket after each emptying. This ensures that all the blood is subject to our estimation.

We chose a 10-l bucket as a collecting vessel to make quite sure that blood loss would be estimated several times during any extensive resection. The result of this estimation is included on the anesthetic record and the total volume recorded in the operating note.

The accuracy of the method and a description of the instrument developed by us were both published in 1976 (HARTUNG et al.)

If blood loss becomes excessive, the surgeon is notified.

3. The Significance of Blood Loss Determination

A surgeon will only become "blood loss conscious" if he regularly finds out the quantity of blood his patient has lost. This is an excellent educational exercise, encouraging bloodless technique among both young urologists and their older colleagues.

Furthermore, if blood loss becomes substantial (see p. 270), further tissue removal should immediately cease and attention be paid to better hemostasis.

The third benefit of running blood loss determination is for the anesthetist, who is thus able to take early measures to stabilize the circulation and request blood from the bank.

Even as a seasoned transurethral surgeon one continues to be surprised by the extent to which one underestimates blood loss.

II. Arterial Bleeding

1. General Considerations

The previous chapters were concerned mainly, and in great detail, with the technique of resection. The problems of hemostasis were consciously excluded. In any real operation, of course, resection and hemostasis go hand in hand, since the transection of any arterial vessel should be followed as quickly as possible by its coagulative closure. Hemostasis presents its own particular technical problems and for this reason is now considered separately from the other elements of transurethral surgery.

I have modeled the following presentation on a variety of monographs. Such imitation seems justified not only on methodologic grounds but also by the high importance of the procedure. Accurate hemostasis is one of the fundamental factors on which the value of the entire transurethral approach is founded.

Fortunately, the modern instruments nowadays available greatly facilitate the detection and coagulation of major arterial bleeds. The excellent irrigating power of these resectoscopes permits good visibility even when three or more large arteries are spurting into the resection field. A variety of endoscopic cinefilms, photographs and video recordings document this state of affairs.

There are nevertheless a number of colleagues who find difficulty in controlling hemorrhage during electroresection. This may result either from inadequate practice, inadequate training, or the use of an instrument no longer up to modern standards.

Transurethral techniques are, furthermore, available for the control of reactionary and secondary hemorrhage following transvesical or retropubic adenomectomy. This is true of both the prostatic cavity itself and of the bladder incision after suprapubic approaches. I remember a case occurring over 20 years ago in which a patient suffered secondary hemorrhage 14 days after transvesical adenomectomy, resulting in so severe a circulatory collapse as to prohibit further surgery. We nevertheless were able to evacuate the tamponade with the resectoscope and coagulate a vessel spurting from the bladder vault incision, thus saving the day.

2. Surgical Anatomy

There has been no shortage of attempts to study the arterial blood supply to the adenoma and adapt resection technique to the ususal arrangement of vessels. The often quoted work of FLOCKS (1937) is certainly the most thorough. He studied the problem by first filling the blood vessels of cadaveric bladders with a barium sulphate solution, dehydrating the specimen in serial alcohols and then developing it in oil of wintergreen (methyl salicylate). This well-known

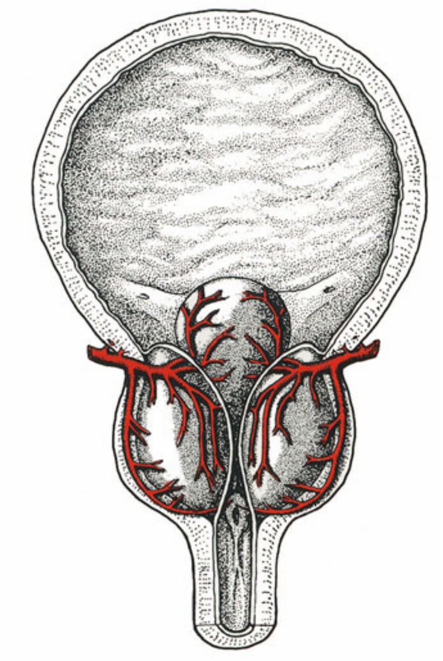

Fig. 175. Arterial blood supply of the prostate. Diagrammatic coronal section through bladder and prostate. The prostatic artery enters the vesico-prostatic junction and divides into external capsular and internal urethral branches. The urethral branch supplies the adenoma, an anatomical fact of which there is ample clinical confirmation. The largest arteries always occur in the proximal cavity close to the internal sphincter. (After FLOCKS 1937)

and often used method of anatomic investigation gives a far more three-dimensional impression that the alternative of radiologic examination. FLOCKS' results must therefore be regarded as more significant than those of KRAAS (1935).

FLOCKS arrives at the following conclusion (see Fig. 175 and 176):

1. Two groups of arteries supply the prostate.
2. The external, capsular group mainly supply the capsule.
3. The internal, urethral group pervade the gland. They enlarge pari passu with the adenoma.
4. The arteries enter the organ in the vicinity of the vesico-prostatic junction.
5. Placed on a clock dial, the point of entry of the arteries lies between 1 and 5 o'clock on one side and 11 and 7 on the other.
6. After entering the gland, the urethral group of vessels at first run medially and then turn distally to more or less follow the urethral axis.

These results are frequently confirmed by clinical observations during surgery. Unfortunately, however, the arterial blood supply is quite variable. One thus regularly comes across vessels, occasionally quite substantial ones, in the ventral region, as described by MITCHELL (1972). They tend to be encountered as one is clearing the roof of the cavity. HAYEK also describes vessels entering ventrally

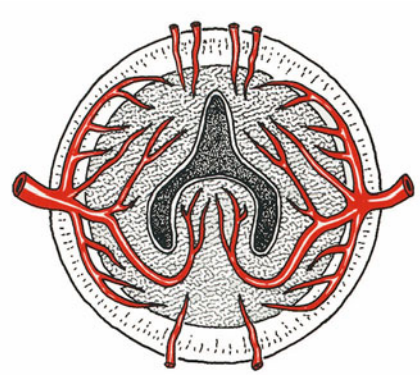

Fig. 176. Blood supply of the prostate. Diagrammatic cross section through the cavity showing radial arrangement of blood vessels. The majority of arteries is encountered in the 3 to 5 o'clock region. Smaller groups appear at 12 and 6 o'clock

and arising from the internal pudendal artery. A few, usually small, vessels may also be encountered in the left and right paracollicular regions.

Naturally the floor of the prostatic cavity also possesses an arterial blood supply, but the vessels are usually of modest caliber.

3. "Anatomical" Operative Techniques

There are two methods of operation aimed at a primary interruption of the arterial blood supply, i.e., that of NESBIT and that of ALCOCK and FLOCKS.

a) The Nesbit Technique

The method of NESBIT is without any doubt the most logical response to the anatomical situation. It is no coincidence that his monograph is preceded by a chapter from the pen of FLOCKS and concerned with the arterial blood supply of the prostate and its role in resection technique (NESBIT 1943).

His concept was a *primary* interruption of the arterial blood supply to the adenoma. By encircling the adenoma tissue with a trench cut close to the capsule, he aimed to interrupt all the arteries supplying hyperplastic tissue. The latter would be then virtually avascular and could be excised with minimal blood loss (Fig. 177).

b) The Technique of Alcock and Flocks

The method proposed by ALCOCK and FLOCKS (see FLOCKS and CULP 1954; FLOCKS 1937) is perhaps less logical in its subdivision of the lateral lobe at

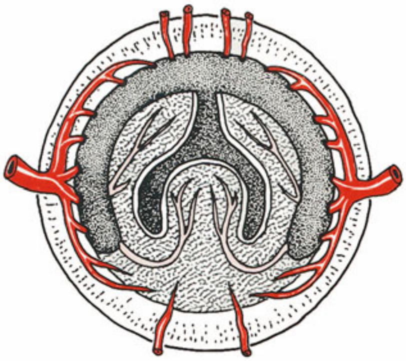

Fig. 177. Prostatic blood supply during operation by the Nesbit technique. Diagrammatic cross section through the prostate. A trench has been cut between capsule and adenoma thus extensively interrupting the blood supply to the adenoma. Further resection of this tissue may now proceed in a more or less bloodless fashion

3 and 9 o'clock by deep grooves. One will always encounter large vessels in these positions. As devascularization of the tissue is incomplete, removal of the latter will not be so bloodless as the technique previously described.

The preliminary devascularization of the median lobe is nevertheless significant, for with few exceptions its arteries always enter from lateral to medial.

c) Other Techniques

All other methods, having the initital removal of a central tissue cone in common, start by exposing the region of the internal sphincter and an area immediately distal to it. This will in itself lead to a relatively early encounter with the feeding vessels. Although the method of Nesbit is undoubtedly the most logical from the point of view of preliminary devascularization, all other techniques that start with exposure of the internal sphincter and immediately distal tissues also guarantee reasonable prophylactic division of main arteries.

Considerable experience has also been gained with preliminary interruption of the vessels supplying a large isolated median lobe. This procedure is based on the fact that the majority of arteries entering the median lobe do so from its lateral aspect. By placing a deep groove at the junction between median and lateral lobes this blood supply may be substantially interrupted. During the rest of the operation only a few insignificant vessels will be found entering the median lobe, usually dorsally through the internal sphincter. Figure 178 clarifies this situation.

Resection thus starts on one side with the placement of a trench deep enough to reach the internal sphincter. One or more vessels will then be divided along the lateral aspect, i.e., at the base of the lateral lobe as they run latero-medially. They may then be coagulated. The same process is repeated on the opposite side, and ablation of the adenoma nodule may then continue without substantial hemorrhage, apart from the few dorsal vessels already mentioned.

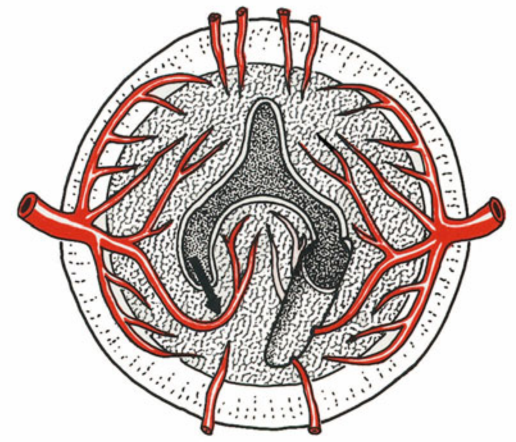

Fig. 178. Technique of resecting a pronounced median lobe. Diagrammatic cross section through the prostate. A channel is cut between median and lateral lobes extensively devascularizing the former. After coagulating the divided vessels, the median lobe may be excised under avascular conditions

4. Detecting Hemorrhage

a) Preliminary Considerations

There is little agreement in the literature on this point, almost certainly a consequence of the variety of instruments and operative techniques in use.

This must certainly be true of MITCHELL (1972), who advises closely approaching the field of resection with the instrument to gain a better view of the bleeding point. BAUMRUCKER (1968) suggests that profuse arterial hemorrhage may be overcome by temporarily raising the irrigator and making use of the additional irrigating channel in the electrotome of the Stern-McCarthy instrument. In his view, uncontrollable arterial hemorrhage may even require suprapubic cystotomy and packing of the resection cavity. Likewise, BLANDY (1971) occasionally sees no other means of controlling arterial hemorrhage than that of opening the bladder and underrunning the bladder neck. On the other hand, CONGER (1963), a pupil of NESBIT'S, recommends a systematic search for the responsible vessels, which may always be found. Under these circumstances visibility may become so poor that nothing further can be seen in the 'bloody swirl.' This brief survey of differing opinions should reveal the variability of various authors' experience. The great pioneers of resection made only brief mention of the detection and control of arterial hemorrhage in their monographs, perhaps because they saw in it no real problem (NESBIT 1943; BARNES 1943).

Further confusion has been caused in recent years by the introduction of the term 'hydraulic hemostasis' (IGLESIAS 1975). In the opinion of IGLESIAS, less bleeding will occur if a continuously collapsed prostatic capsule is allowed to maintain almost complete closure of all venous channels. A similar suggestion is made by Reuter (1980) in relation to trocar drainage. To date there is a lack of any proper comparative study of hemostasis by these two systems. Hydraulic hemostasis is thus so far an unproven and speculative concept.

Our own experience, based on 500–600 electroresections per year, agrees best with the requirement made by Conger that *every,* absolutely every arterial bleeding point should be visualized and subsequently coagulated. We have been able to demonstrate this concept to numerous visitors to our clinic by a variety of films, video recordings and demonstration resections with a teaching attachment.

There are a number of reasons for this approach:

b) Instrument Factors

With the aid of the manufacturer (Storz), we have been able to so modify our resectoscope that adequate visibility will be maintained in the face of the most profuse hemorrhage, so that the bleeding vessel may always be seen. The changes in design have been mainly qualitative. The improvements were achieved not by simply increasing the rate of irrigation flow but by improving its collimation. No doubt other manufacturers will have found similar solutions.

c) The Value of Experience

Naturally enough, the detection of bleeding arteries was a serious problem to be solved only by great application and patience in the early years when we were virtually self-taught. In all the years since 1952, when I first began to take an intensive interest in transurethral surgery, I have only once (in over 8000 electroresections of the prostate) had to open the bladder for uncontrollable hemorrhage and pack the prostatic cavity. In fact this was for massive parenchymatous hemorrhage due to consumption coagulopathy, not for arterial bleeding.

A sequence of actions during an operation frequently becomes so automatic to the surgeon that a number of maneuvers are carried out subconsciously. Only teaching sessions in which he supervises, and if necessary, corrects the work of a less experienced colleague may draw his attention to various minutiae. Thus this chapter could never bave been written in the present form had I not been able to draw on my teaching experience.

5. Prerequisites for the Detection of Hemorrhage

a) A Suitable Instrument (Habituation to a Preferred Instrument)

Every resectoscope has its own special characteristics to which one must become accustomed, just as when driving an automobile. Virtually all modern resectoscopes are of adequate quality as far as tissue removal is concerned. Problems arise when profuse hemorrhage threatens visibility with a resulting loss of orientation. By modern technical standards, therefore, a good resectoscope must also be capable of maintaining clear visibility of the resection field under the worst conditions of massive bleeding from one large or multiple small arteries. The detection of one ore more arteries must always remain possible. Unfortunately it would appear that not all instruments satisfy these requirements as indicated in the literature review given above. We have come to the same conclusion when testing various instruments, all of which gave excellent results at the beginning of an operation, in fine weather, as it were. Once hemorrhage occurred, however, further surgery was rendered so difficult by some of these resectoscopes that in the interests of the patient we had to change back to our tried and tested, improved instrument. No doubt, habit is a considerable factor, but anyone who has had frequent opportunity to test a variety of instruments will be well aware of true variations in quality. This manual is not intended to provide propaganda for any one manufacturer, but I would nevertheless wish to emphasize that any surgeon who frequently encounters difficulties he ascribes entirely to his own technique, should at least bear in mind the real qualitative differences between individual instruments.

b) Resection Technique

α) Clear Visibility of the Resection Cavity. Blood vessels are difficult to recognize if the resection area is irregular or fissured. The smoother the surfaces within the wound, the more easily a spurting artery may be recognized and its location approached. The various methods designed to maintain clear orientation within the cavity have been discussed in Chapts. D and E in great detail.

β) Dividing the Operation into Stages. A less extensive, limited resection area is more easily kept under control than a wound involving the entire prostatic cavity. The resection techniques described in previous chapters aim at subdivision of the operation not only to maintain orientation but also to facilitate hemostasis. If one makes it an absolute rule to conclude resection of one region with scrupulous hemostasis, difficulties never arise. When vigorous hemorrhage does occur within the sector one is working on, the artery is to be sought within a limited area and will therefore be more easily found.

γ) Matching the Irrigation Rate. The rate of irrigation flow and the severity of hemorrhage should be carefully matched. This is particularly true for the detection of minor bleeds. The interrelationship is easily appreciated if a small vessel is approached first with copious and then with decreasing irrigation. If the flow is too little, one will see a red cloud completely obscuring the view, so that the origin of the vessel is unrecognizable. A slight increase in flow will render the vessel and the stream of blood entering the lumen of the cavity clearly demonstrable. Further increase in irrigation will tend to flatten out the

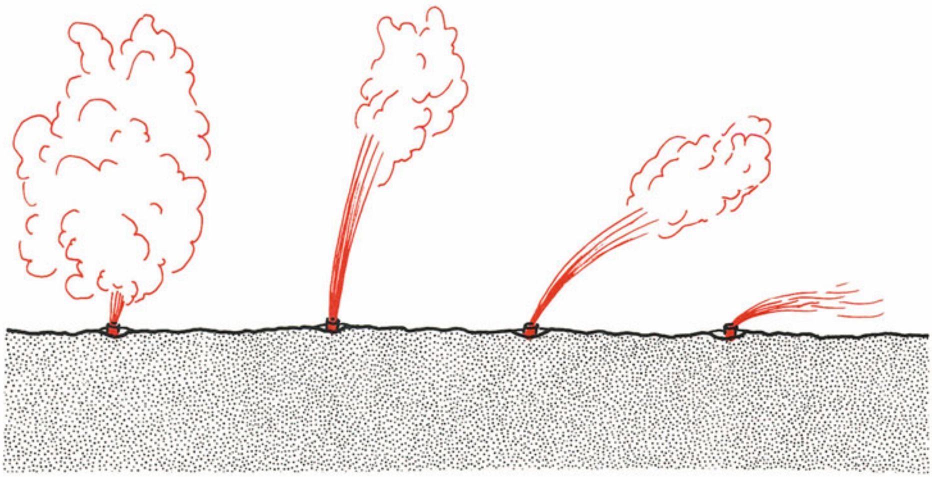

Fig. 179. Effect of irrigation flow on blood jets. *From left to right:* Regression from weak to maximal irrigation. Gentle flow permits the formation of an obscuring cloud while overvigorous irrigation clears the blood so rapidly as to make the bleeding point undetectable

jet of blood which then only remains detectable because its origin and direction are known (see Fig. 179).

This interrelationship between irrigating flow and severity of arterial bleeding is *not* of course valid for the recognition of particularly large arteries. These inevitably require maximum irrigating power, but in modern instruments the latter is always adequate for the demonstration of the very largest vessels.

The reduction of irrigation rate attains particular significance when venous bleeding points are to be demonstrated. They may require so great a reduction of flow as to amount to a virtual cessation of irrigation. Only thus may, e.g., tenuous submucous vessels around the mucosal margin of a bladder tumor or at the distal and proximal mucosal margin of the wound cavity be recognized. Complete closure of these vessels requires only a short burst of current, yet their coagulation is of great significance for the reduction of postoperative bleeding. They are after all so numerous that the summation of many small bleeds may amount to substantial hemorrhage.

δ) Position of Instrument and Cutting Loop. As previously suggested, individual resectoscopes vary greatly in their ability to reveal bleeding points. Anyone who has worked with a variety of instruments will realize that each has its individual characteristics to which the operator must adapt.

I have therefore found it impossible to give general rules on how best to hold the instrument or the best position of the cutting loop when searching for bleeding points, since these factors may vary considerably from instrument to instrument. I merely draw the reader's attention to the fact that one instrument may provide the best view of a vigorous arterial bleeder if it is closely approximated to the wound cavity, while another model may give the best results at some distance from the bleeding point.

The same is true of the cutting loop which will always have some effect on the irrigating performance of its instrument and thus on visibility.

The best position of instrument and loop for any given model must be discovered by the surgeon himself and experimented with by *conscious* alterations in technique. I have put forward these personal observations purely in the hope of helping some readers with their own hemostatic problems.

ε) Immediate Closure of all Arteries. In conversation with colleagues one may frequently hear how they will leave it to the end of a stage of resection to look for and coagulate remaining vessels. I cannot give an emphatic enough warning against such practice. The basic surgical principle of arresting hemorrhage as soon as it occurs applies to transurethral operations just as to open surgery. After all, no urologist would dream of delaying hemostasis in the musculature until the end of pyelolithotomy. There are a variety of important reasons for closely adhering to the principle: "stop bleeding arteries immediately."

c) Rationale for Immediate Hemostasis

1. Patients should be spared avoidable and unnecessary hemorrhage.
2. Reduced hemorrhage improves visibility.
3. Reduction of bleeding prevents the formation of coagula within the field of resection and in the bladder. Orientation within the wound cavity is thus maintained.
4. In large adenomas considerable blood loss may occur by the summation of minimal bleeds from multiple small vessels.

It is not infrequently said that immediate coagulation of every artery, as it is opened, is too time-consuming a method. The very reverse is the case, since it is at the time of opening a blood vessel that the event is immediately obvious. The cutting loop may then be immediately applied to the site of hemorrhage and coagulation undertaken. The entire process takes but a few seconds and barely influences the progress of resection.

There is a single exception to this rule: if a series of cuts are being made with the aim of exposing a given zone of the capsule, a superficial artery may be encountered early. Nevertheless, resection should continue until the main trunk of this artery is revealed. That is inevitably the case at the time of reaching the capsule.

This procedure is *not* recommended to the less experienced resectionist who may have difficulty in estimating whether the current cutting series is likely to reach the capsule. He would be well advised to close the incised vessel immediately, even if it is likely subsequently to reappear at some other point in the operation.

6. General Rules for the Detection of Arterial Bleeding

Arterial bleeding points may be recognized by a variety of features:

1. The actual lumen of the vessel may be seen from which blood is issuing.
2. A jet of blood may be seen squirting into the prostatic cavity.
3. The vessel itself may be seen with or without blood flow.
4. The irrigating fluid discolors rapidly, thus alerting the surgeon.
5. Under certain circumstances (a large vessel spurting straight into the sheath) there may be rhythmic lightening and darkening of drained irrigating fluid.
6. A red cloud forms immediately at the point where an artery is opened during a cut, since blood is not able to squirt freely into the resection cavity, being deflected by the chip and the cutting loop. A fountain jet of arterial blood will not occur until the chip has fallen back into the bladder.

a) Finding Arteries During Resection

One or more of the above six events will make the surgeon aware of having opened an artery.

In the simplest case the source of bleeding will be found as follows: the jet of blood is easily visible and with it its vessel of origin. It only remains to lay the cutting loop across the lumen of this vessel.

A more difficult situation arises if the vessel is not immediately visible. The basic rule is to adjust the irrigating flow to the severity of hemorrhage, reducing it to a minimum if the blood loss is slight, increasing it to maximum if it is profuse. Arteries are most easily found by withdrawal of the instrument to the observation point (aperture opposite the verumontanum) and adjusting the irrigating flow as required. An experienced operator is usually well aware of the size of bleed. I would recommend beginners to start their search under maximum irrigation and gradually reduce it.

Illustrations 47 (Plate VIII) and 49–51 (Plate IX) clearly demonstrate these problems. In Illustration 47, the irrigation rate has been moderated so as to allow the small vessel immediately beneath the large artery to remain visible. In Illustration 49 the irrigation is just adequate to wash away blood issuing from the larger artery. However, the jet of blood ricochets from the opposite wall of the prostatic cavity (see Fig. 184) giving rise to a bloody cloud at the upper border of the picture. On the other hand, in illustration 50 irrigation is too forceful, completely washing away blood leaving the smaller artery (cf. Fig. 179).

The problems arising from massive hemorrhage will be further discussed elsewhere. At this point, we will discuss how to find the artery responsible for moderately profuse focal hemorrhage. The instrument is withdrawn to the observation point. Irrigation is then adjusted to the rate of bleeding so as to reveal a jet of blood crossing the wound cavity. Since this jet will become wider the more distal, and narrower the more proximal one is to its point

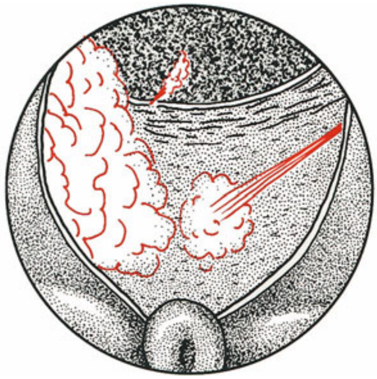

Fig. 180. Diagrammatic view of the operative field from the "observation point." The sheath aperture of the instrument has been placed at the level of the verumontanum or slightly distal to it, depending on the conformation of the resection cavity. The irrigation flow has been so adjusted as to visualize smaller arteries. This allows blood to ooze from a venous sinus on the right-hand side of the patient (*left* of the picture) so copiously as to fill that half of the cavity. A small mucosal vessel is demonstrated at the epithelial margin in the proximal field. An artery squirts from the left lateral lobe region at approximately 3 o'clock downward into the floor of the resection cavity

of origin, the latter is found simply by tracing the jet backward to its exit point from the tissues (Fig. 180). For the sake of clarity, this process has been described in great detail, but in practice it takes merely a few seconds.

b) Appearance of the Vessel Stump

The lumen of virtually any transected vessel is easily recognized within the field of resection. This has been facilitated both by the increased resolving power of modern telescopes and by the improved illumination available with fiber optics. That is particularly true of small arteries, visible through previous operating telescopes only by the associated jet of blood. Nothing larger than the precapillary lumen is nowadays invisible to modern optical systems.

This is best illustrated by a series of endoscopic photographs showing vessels of varying caliber (Illustration 47, Plate VIII, Illustrations 49 and 50, Plate IX). These show the way in which larger vessels always protrude somewhat above the surrounding plane of dissection, an effect due in part to the mechanical toughness of the arterial wall, and in part to the constant presence of a periarterial fat sheath. The flexibility of the latter allows adenomatous or capsular tissue to slide back and leave the more rigid vessel protruding like a tree stump from the resection field. Illustration 47 (Plate VIII) gives a good view of such a periarterial sheath. Fat droplets may be seen shimmering through between fine capsular fibers. The vessel stump can be seen after coagulation in Illustration 48 (Plate VIII), projecting into the center of the picture just above the large air bubble. The smaller an artery, the less it will project beyond the surrounding plane of section. Larger vessels have a more or less oval cross section, while smaller ones are round.

c) Multiple Arteries

The main branch of an artery supplying the urethral field does not always appear as a single vessel, and it not infrequently occurs that a number of arteries are divided at one point, often by a single cut (e.g., Illustration 47, Plate VIII, Illustration 51, Plate IX). This state of affairs results from early branching of some vessels, a helpful variation, since the individual vessels are more easily seen and sealed than would be one large profusely bleeding trunk.

7. The Technique of Coagulating Vessels

The vast majority of all surgeons use the resectoscope loop for hemostasis. In bygone years a variety of special probes were popular and are still available in most manufacturers' catalogues. One such accessory is fitted with a broad-surfaced rolling ball intended to be used for generous crusting coagulation of wide areas of the resection field.

In only a few specific cases is the use of such an electrode sensible. In general, such a procedure is harmful and gives rise to unnecessary necrosis in the operating field. One of the few indications for superficial coagulation is parenchymatous bleeding from the bed of a prostatic or bladder carcinoma. Apart from its undesirable side-effects, the use use of broad-surface probes is also considerably less effective than carefully aimed point coagulation.

There is a further important reason for using the cutting loop in hemostasis: coagulation of a vessel will then not require a change of instrument (loop to probe) and can be rapidly carried out without interrupting the general working pattern.

How is contact to be made between loop and vessels? For small arteries it is enough to briefly touch the bleeding point with the loop for hemorrhage to be immediately arrested.

Larger arteries up to 1.5 mm, rarely even up to 2 mm outside diameter, are only reliably closed if excellent contact is achieved between artery wall and loop. I prefer *side-to-side* contact between loop and artery (Fig. 181). The hemostatic process consists of a reticular disintegration of the elastic coat which then bulges so firmly into the lumen of the vessel as to close it. Cases of partial vessel closure will sometimes occur when the center of the vessel has been coagulated but blood continues to spurt from either corner. Only further coagulation will bring about complete hemostasis. Finally, to round off the process, I run across the vascular lumen from above several times so as to be quite certain of avoiding subsequent reactionary hemorrhage.

Toward the end of the resection, the cutting loop will often have become so thin at its midpoint as to sink into the tissues when coagulation is attempted. This results from current concentration due to the thin cross section of the wire. If it arises, this problem may be easily solved *without* having to change the loop by using its less eroded end portion for vessel coagulation (Fig. 182).

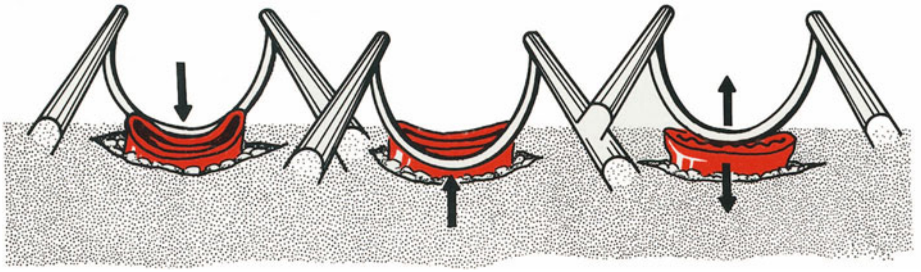

Fig. 181. Diagram showing coagulation of a large artery. During resection of large adenomas it is not uncommon to come across arteries of 1–2 mm diameter which need to be carefully sealed. Our technique, which has stood the test of time, coagulates first one side and then the other of the elliptical vessel, finishing with further coagulation of the cut surface itself. This results in intimate fusion of the inner surfaces of the vessel and produces a low incidence of secondary hemorrhage due to opening up of the coagulation point.

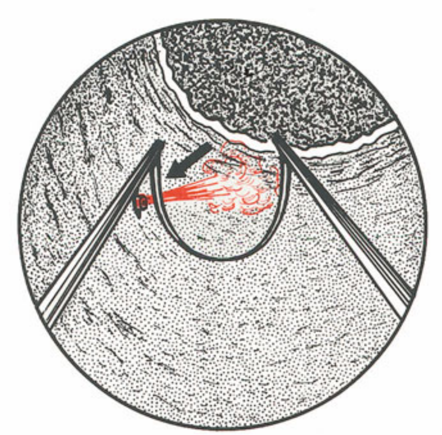

Fig. 182. Coagulating a vessel with the lateral portion of the loop. Toward the end of a lengthy resection, the central portion of the cutting loop is not infrequently considerably consumed. It then produces too intense a current density to provide adequate coagulation or prevent a cutting action in the tissue. This may be avoided by using the thicker, virtually untouched lateral portions of the loop for coagulation. The only alternative to this technique is to change the loop

8. Special Problems of Hemostasis

Control of bleeding is sometimes rendered difficult, either by the invisibility of the vessel, or because the direction of the jet of blood itself is so unfavorable as to obscure visibility. That is particularly prone to occur if the vessel is directed straight into the sheath or if blood rebounds off the opposite capsular wall with such force as to inhibit irrigation. These problems are now discussed individually together with the methods for their control.

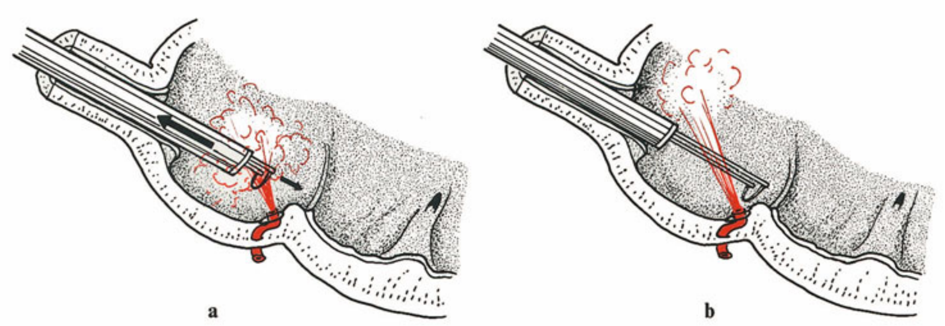

Fig. 183a, b. Large artery spurting toward the resectoscope. a This situation may cause difficulties if the irrigating flow is inadequate to keep the front lens clear of the blood that squirts toward it, with marked impairment of visibility. Rather than undertaking virtually blind, uncontrolled attempts at coagulation the operator should change the position of the instrument so as to avoid the direct blood jet. **b** The resectoscope sheath has been retracted and the cutting loop maximally extended so as to reach the vessel. Although visibility may still be somewhat worse than usual, contact with the vessel may be detected as a sudden change in quality and direction of the blood jet. Cutting current is applied and contact with the vessel repeatedly made so as to bring about provisional closure. This allows the proper conditions for definitive coagulation under full vision according to the technique shown in Fig. 181. Incomplete coagulation of a large vessel not infrequently so narrows the central portion of the lumen that the jet is divided into two with a figure 8 configuration of the lumen

a) Arteries Spurting into the Instrument

This problem arises whenever an artery is so incised that the blood jet is directed toward the verumontanum. The latter is after all the site of the resectoscope sheath. In unfavorable cases the vessel may squirt straight into the lumen of the sheath. The nearer one comes to the artery the more forcefully blood will spray against the front lens, thus preventing orientation at close quarters (Fig. 183).

Solution

1. The axis of the instrument is turned away from the “firing zone” of the artery. This is achieved by trial and error.
2. The instrument is now retracted as far away from the spurting artery as possible and coagulation undertaken with the loop fully extended.
3. Pressure by the instrument sheath on tissue surrounding the vessel will at least partly compress the latter (see Fig. 191).
4. In regions accessible to rectal palpation (i.e., dorsally) the same may be achieved by a finger in the rectum (possible combination of Steps 3 and 4).

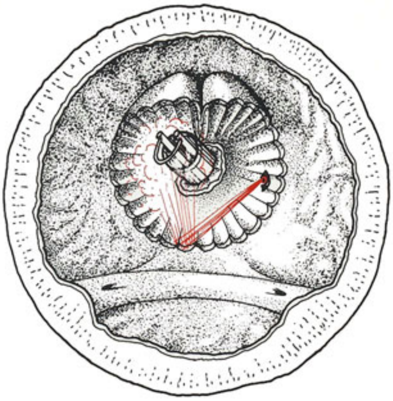

Fig. 184. "Ricochet" bleeding. Diagrammatic cross section of the lower bladder seen from above. An artery on the right-hand side of the prostatic cavity squirts through the wound across the floor of the prostate. The stream of blood is then reflected and dispersed so as to give the observer an initial impression of poorly detectable venous sinus. Careful inspection of the entire periphery of the cavity by conical movements associated with advancing and retracting the instrument will at some stage encounter a blood jet. Coagulation of the vessel is then rendered simple: the jet is simply traced back to its point of origin which is then coagulated

b) Ricochet Bleeding

The site of an artery squirting straight across the resection field to the opposite side of the cavity may be masked by a "ricochet" effect. There will then be a dense cloud of blood on one side of the cavity which may be erroneously attributed to a venous sinus or some other unidentified bleeding point (Fig. 184).

Solution

1. Retract the instrument to the observation point (approximately level of verumontanum). From here, inspect the cavity under various irrigating conditions. The instrument should scan a conical region of the cavity, and this movement may be compounded with cautious retraction and advancement of the instrument. At some point the primary, i.e. not the reflected blood jet will be identified and may then be traced back to its point of origin.
2. Desist from inspecting the "cloudy" side and concentrate contralaterally. In this region, inspect the circumference of the cavity in radial segments until a spurting artery is detected.

c) Bleeding from Behind a Tissue Eminence

Occasionally an arterial lumen remains undetected behind a protuberant piece of tissue. Bleeding is clearly observed in a given region, but the bleeding point itself cannot be located (Fig. 185).

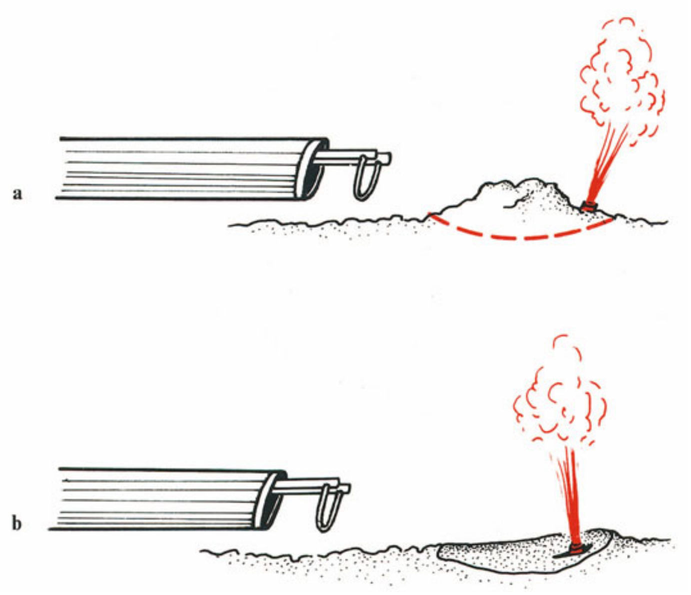

Fig. 185a, b. A vessel behind a tissue hillock rendered visible. a The vessel cannot be located with certainty because a small tissue bulge obscures its outlet. Only its direction can be determined. Rather than executing blind and ineffectual coagulation, it is safer to ablate the obscuring tissue. **b** Arrangement after correction of the tissue surface. The projection has been ablated and the vessel is now easily visible and coagulated

Solution

A few smoothing cuts are undertaken in the region of bleeding. The responsible artery will then rapidly be exposed and may be coagulated.

d) Bleeding Under Coagula

Whenever the rule of immediate hemostasis is abandoned, clots may form. During final hemostasis at the end of the operation, irrigating water will repeatedly be returned strongly blood-stained although no bleeding point can be detected. Under these cirumstances a covered bleeding point under a blood clot should be suspected (Fig. 186).

Solution

The clots should be removed by use of the loop, either as a blunt curet or, if the coagula are strongly adherent, with current applied. The bleeding point may remain invisible if thin, firmly adherent layers of clot deflect the blood flow, and in such cases two further measures will help to reveal the vessel:

1. Undertake a smoothing cut at this point
2. Inspect the region under minimal irrigation

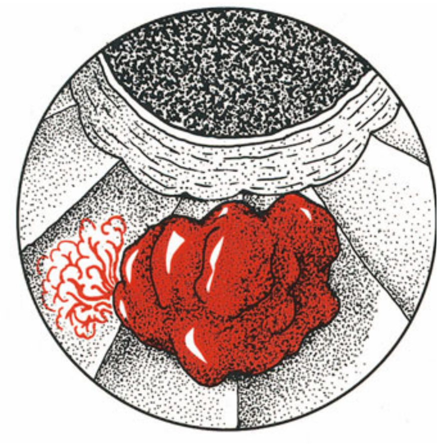

Fig. 186. Blood oozing from under a blood clot. This situation not infrequently occurs on the floor of the cavity. Blood clots have become attached to the basal region of the cavity by coagulation. They cover the vessel whose blood was initially responsible for forming this clot. Blind coagulation is pointless in this situation since there is no chance of accurately contacting the vessel and the blood clot will so dissipate high frequency current from the surrounding tissue as to render it ineffective. Only blunt curetting or, if necessary, sharp resection of this region with a few shallow slices followed by accurate coagulation of the vessel will be of any use

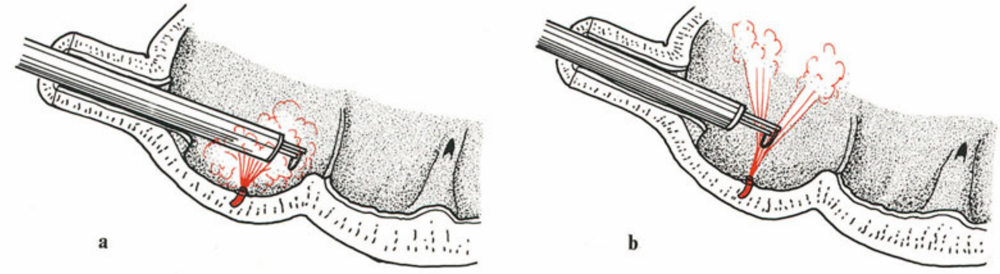

Fig. 187a, b. Method of staunching profuse hemorrhage. a It is frequently quite difficult to locate extemely large vessels with accuracy. The sheath aperture lies in a dense cloud of blood of uncertain origin. **b** The instrument is withdrawn from the densest zone of hemorrhage. The extended loop is moved back and forth across the tissue surface. A point will be found at which the blood flow suddenly divides in two around the loop. If the loop is then lowered onto the tissue surface it will come into contact with the vessel. Frequently, light pressure from the loop onto the tissue surface is enough to briefly compress the vessel and arrest hemorrhage. Coagulation and closure are then rendered easy (see also Fig. 183 and 191a, b)

e) Massive Hemorrhage

Occasionally, mainly during the final stages of operation, so large an artery may be opened that the entire operating field turns dark red and impenetrable from one moment to the next (Fig. 187).

Solution

Despite making a dramatic impression on the beginner, this situation is easily brought under control. Note the general direction of the source of bleeding and empty the bladder. Irrigation of an empty bladder is always considerably more powerful than when it is full. While draining the bladder, direct the instrument toward the source of bleeding, so as to lose no time when irrigation recommences. An instrument with a central irrigating cock is of great value (see instrument descriptions, p. 17, 145). The further procedure is then similar to that for vessels directed toward the field of view.

The instrument we use has such excellent irrigating power that the direction and approximate site of the bleeding point is always recognizable. The fully extended loop may then be used to "search" (see p. 267) for the vessel in this region. Contact with the loop will be evident by a brief interruption of the hemorrhage, or by a change in its direction. If, and only if, this occurs the vessel may then be coagulated by a series of passes with the energized loop across the area of bleeding. Such massive hemorrhages are rare and with a little patience they may always be brought under control within 1–2 min. This blind coagulation will occasionally only partly close the vessel and more precise localization will then be required for complete hemostasis.

Within the prostatic cavity, arteries are always visible as prominent stumps projecting into the lumen, and it is therefore possible once hemostasis has been secured to recoagulate them by several seconds close contact with the cutting loop. This gives protection against reactionary hemorrhage.

f) Ventral Bleeds from the Vesicoprostatic Junction

If an artery is incised in the transitional region between bladder and prostatic capsule, it may be withdrawn from the field of view by distension of the bladder and thus become inaccessible to coagulation. The blood jet is seen but its source cannot be attacked with certainty (Fig. 188).

Solution

1. Empty the bladder keeping the instrument directed toward the vessel. An instrument with central irrigating cock is most useful (see instrument description, p. 17, 145). As the bladder empties, the roof of the cavity sinks dorsally, and the vesicoprostatic junction comes into view. Carefully metered, gentle irrigation with the patient in head-down tilt will allow the vessel to be visualized and coagulated.
2. The same result may be achieved if the vault of the empty bladder is pressed down toward the instrument (by the surgeon or by an assistant).

Although it is frequent mentioned in the literature, this type of hemorrhage is rare, since resection does not proceed into the bladder but remains limited by the internal sphincter. If points 1 and 2 are carefully observed, bending

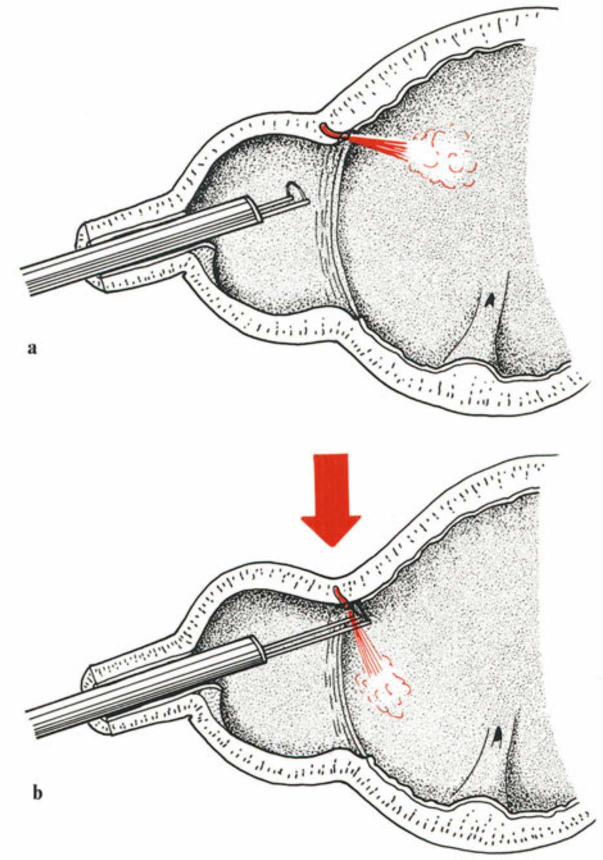

Fig. 188a, b. Detecting hemorrhage at the vesico-prostatic junction. a Inspection of the bladder neck reveals a bleeding point in the 12 o'clock region, but of uncertain origin, since the artery is spurting into the lumen of the distended bladder where it is obscured from view from the bladder neck. **b** The artery is easily brought into view if the bladder is emptied and/or pressed down dorsally from above. The arterial channel can be easily seen and coagulated. Once again, blind coagulation is occasionally successful but takes time and may cause unnecessary tissue damage. It is more appropriate to use a suitably specialized technique

of the resectoscope loop as advocated by Baumrucker (1968) is quite unnecessary.

Weyrauch (1959) has suggested that in this situation the bleeding area be inspected during drainage of the bladder. The reason behind this suggestion is no doubt that experience has shown that the vault of the bladder and roof of the prostatic cavity sink as the bladder empties, thus revealing the vessel.

g) Poor Hemostasis in Previously Coagulated Tissue

Occasionally a clearly visible bleeding point proves difficult to coagulate when the surrounding tissue has already been diathermied. Blood continues to ooze

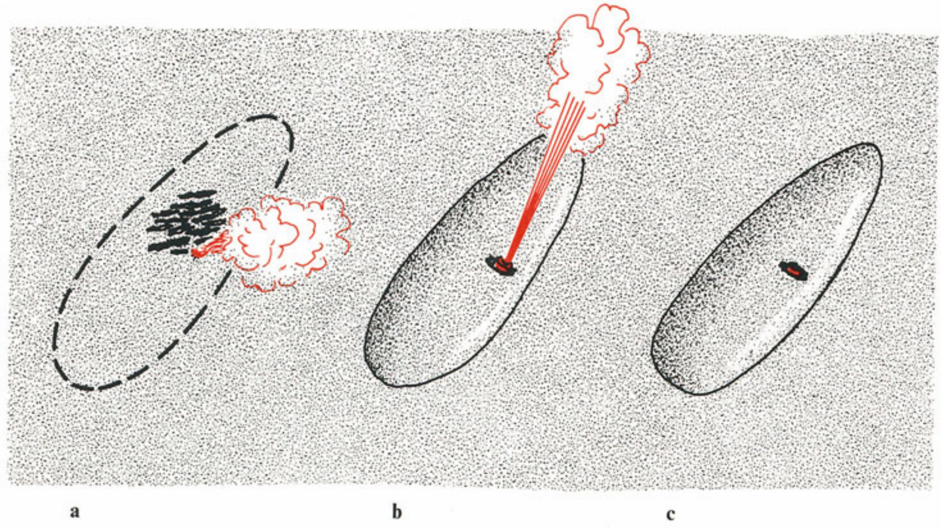

Fig. 189a–c. Incomplete hemostasis in previously coagulated tissue. Final inspection at the end of resection occasionally reveals areas of coagulation which are still bleeding despite extensive crusting. Sometimes the bleeding point is rather vaguely localized but appears more clearly on a further inspection of the area. Reduction of irrigation to an absolute minimum may reveal a trickle of blood to one side of the coagulated area (**a**). The only solution to this problem is to freshen the coagulated area with a shallow cut into the tissues (**b**), if the anatomical location allows. Coagulation is easily achieved in fresh and clearly visible tissue (**c**)

or squirt out of dark areas of coagulated crust. Even extensive coagulation without thought for the resulting tissue necrosis may not arrest such bleeders (Fig. 189).

Solution

Nothing will help except freshening of the cut surface by excision of the entire coagulated area. The current will often have a poor cutting effect, necessitating *short-term* increase in power settings. The vascular lumen is easily identified in freshly sectioned tissue and may be closed by a short burst of current.

If proximity of the capsule prohibits any further cutting, control is *always* achieved by means of a conical coagulating probe at the point of which a highly effective current density is generated.

h) Arterial Bleeding at the Margin of a Venous Sinus

Prior to the introduction of Hopkins and other modern optical systems with their high resolving power, these small vessels, probably vasa vasorum of a venous sinus, were not easily detectable (Fig. 190).

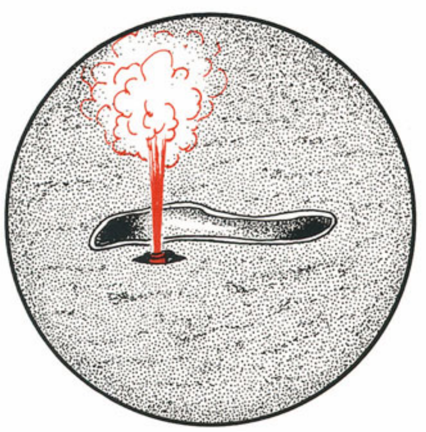

Fig. 190. Arterial bleeding at the margin of the venous sinus. In the final phase of hemostasis, it is easy to overlook small arteries that were divided along the margin of the venous sinus. Blood flowing from the venous sinus under minimal irrigating conditons may then obscure the fact that arterial vasa vasorum are frequently present along its margin. During any final check of hemostasis careful attention should therefore be directed toward these vessels so easily overlooked along the margin of the sinus

Solution

The sinus is brought into view and the irrigating flow is so regulated as to just prevent any further bleeding from the vein. A small artery may then not infrequently be seen along the margin of the vein and found amenable to coagulation in the usual fashion.

i) Pseudohemostasis

This term applies to the following phenomenon. From the observation point, a vessel is clearly seen spurting into the resection cavity. As the instrument is directed toward the vessel in an attempt to visualize it more closely, the bleeder is suddenly lost to view despite correct location of the instrument. The cause for this lies in compression of these usually small arteries by the resectoscope sheath with consequent arrest of hemorrhage (Fig. 191).

Solution

1. The problem is often difficult to overcome since angulation and gradual withdrawal of the sheath will first be required to re-establish bleeding. The sheath must be moved in such a fashion as to reverse its compressing effect on the vessel. Retraction of the sheath sometimes helps to free the tissue from pressure effects. Once this has occurred, the loop alone is gradually

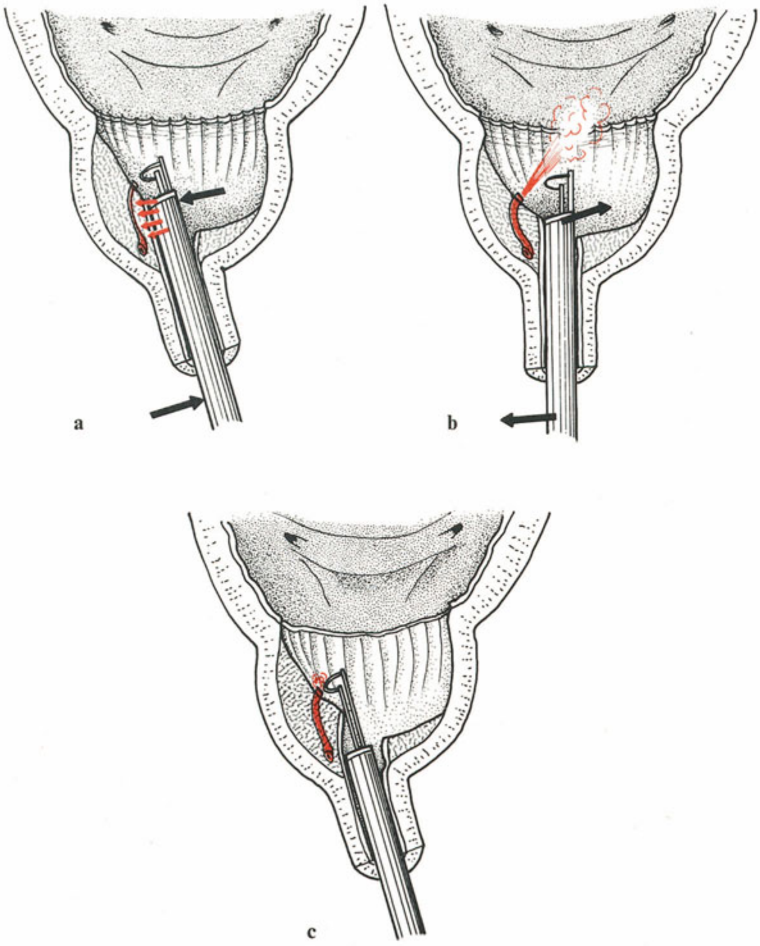

Fig. 191 a–c. "Pseudohemostasis." Pressure by the resectoscope sheath on the tissues may so compress arteries as to prevent them from bleeding; this process is known as pseudohemostasis. **a** Diagram showing the mechanism of this phenomenon. The end of the sheath presses on the tissues and subjacent vessels. Although the arterial lumen is clearly seen, no blood emerges. **b** A converse movement (lifting the sheath away from the tissue) relieves the pressure allowing the artery to bleed once more. Further attempts at coagulation will lead to renewed pressure of the sheath on the tissues and cessation of hemorrhage. **c** The solution is simple. The sheath is withdrawn so that the intervening tissue may bulge up between aperture and loop. The bleeding point is now easily seen and coagulated by this maneuver. Occasionally, the intervening tissue obscures the line of view and will then need to be ablated as described in Fig. 185 in order to restore visibility

readvanced toward the vessel without any other movement of the sheath. This should avoid renewed pressure on the vessel.

2. If the artery is of such a lumen as to be visible within the local tissue structure, it may be coagulated in the absence of evident hemorrhage. The success of this maneuver should be checked from the observation position.

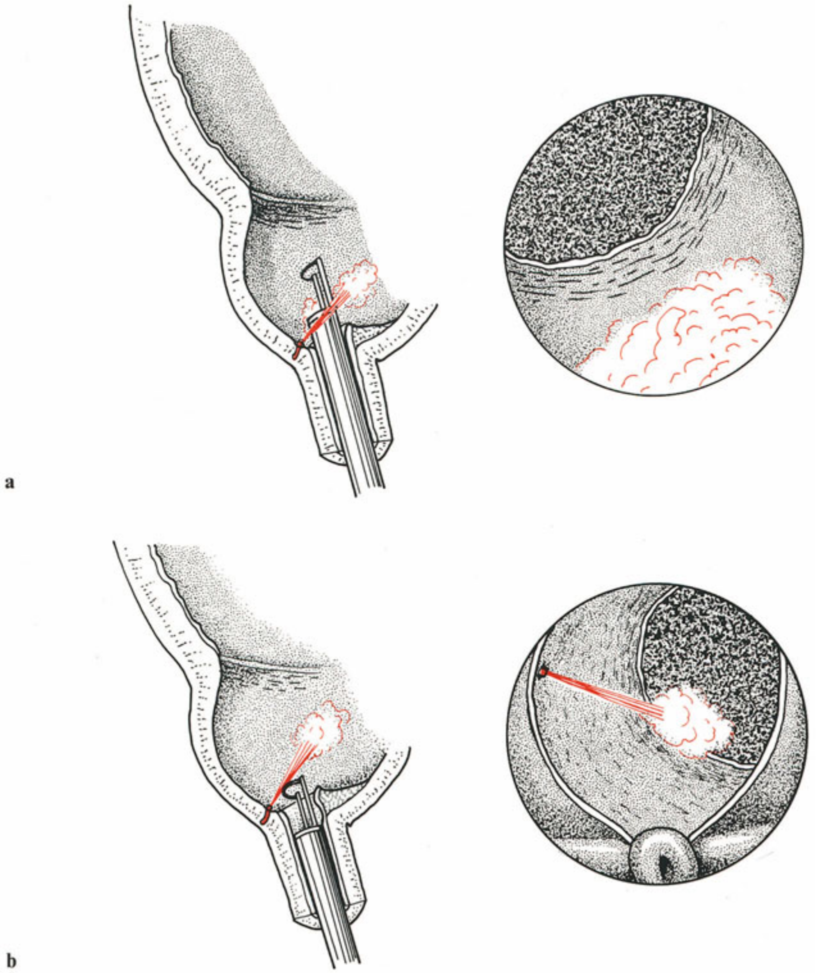

Fig. 192a, b. Detecting bleeding points at the distal resection margin. a During final inspection of the wound cavity for bleeding points at the end of the operation, It occurs from time to time that the cavity appears entirely dry of blood and yet the irrigating fluid nonetheless returns blood-stained. In this situation a careful search should be made along the distal margin of resection. Alternatively, there may on occasion be a blood cloud of uncertain origin. **b** The spurting artery may be easily visualized by carefully inspecting the entire circumference of the distal margin of resection. This requires considerable distal retraction of the sheath. Coagulation of the vessel, once recognized, affords no problems

j) Hemorrhage in Distal and Proximal Extremities of the Field

Such bleeding points may be difficult to locate if not expressly looked for. During inspection of the cavity, the instrument is usually held slightly proximal to the verumontanum. Any vessels further distal to this point will be invisible (Fig. 192). The same is true of arteries at the proximal margin of resection an area which is often neglected because attention centers on the resection field proper, not on peripheral areas.

Solution

Withdraw the sheath distally beyond the verumontanum and inspect the resection margin under minimal irrigation, since the vessels involved are usually small. The same is true of the proximal margin. Once again, there may be numerous minute arteries, the sum activity of which may constitute substantial bleeding.

III. Venous Bleeding

1. General Considerations

For the sake of clarity I have subdivided this discussion on operative bleeding into arterial and venous hemorrhage. As in any systematic discussion, this arrangement does not correspond to the operative realities, since of course arteries and veins are often opened simultaneously. However, venous bleeding will only be appreciated during the procedure if the irrigating flow is markedly reduced once arterial hemostasis has been achieved. Furthermore, the bladder should not be completely filled so as to prevent hydrostatic pressure within the wound cavity exceeding the venous pressure. Small veins in the vicinity of the mucosa are of little significance, but those within the field of resection are important since they represent a portal of entry for irrigating fluid into the circulation, resulting in the well-known clinical pictures of dilutional hyponatremia or TUR syndrome.

Greater operative significance attaches to the venous sinuses, which appear in the field of resection as voluminous, thin-walled clumps of vessels (see Illustration 53, Plate IX). The sinuses may be the source of profuse bleeding that tends to be overlooked by the inexperienced surgeon until the end of the operation. Furthermore, considerable quantities of irrigation fluid may be "infused" into them during the procedure, resulting in the already mentioned clinical events.

2. Surgical Anatomy

There are two venous systems of clinical importance.

a) The Submucous System

A submucous venous plexus may be easily recognized on inspection of the bladder neck. The degree of distension of these vessels varies considerably.

If compression by a rapidly enlarging adenoma interferes with venous drainage, they may occasionally be engorged to the point of varicosity. BARNES (1943) believes the distension of these veins to be an index for anticipated hemorrhage during surgery.

b) The Deep System

Venous sinuses are always encountered as the capsule is exposed and partially incised during resection. These vessels are extremely thin-walled and lie embedded in loose connective tissue. Not infrequently, a small accompanying artery may be recognized adjacent to the transected venous channel. The most frequent location for venous sinuses are the regions between the 3 o'clock and 5 o'clock and 7 o'clock and 9 o'clock respectively. They lie approximately in the center of the bladder neck.

Calibers may vary between 1–2 mm for small vessels and 3–5 for larger ones (see Illustrations 52 and 53, Plate IX).

3. Detection of Venous Bleeding During Surgery

As already observed at the outset, venous hemorrhage is barely or not at all noticeable so long as the resection field is irrigated under pressure in excess of that in the peripheral veins. Hydrostatic pressure within the full bladder is considerably higher than the venous pressure and far from blood then escaping from the venous system, irrigating fluid may enter it. Furthermore, even when the intravesical pressure is quite low the dynamic pressure seen by veins under full irrigating flow in the resection field may be so great as to render venous bleeding undetectable.

a) Inspection of Irrigation Drainage

Bleeding from larger venous sinuses will become apparent as discoloration of drained irrigating fluid. If initial drainage of the bladder yields fairly pale and lightly blood-stained water followed by more heavily colored, bloody fluid at the end of drainage, there is a high probability that a venous sinus has been opened. If this observation is continued to the point of complete bladder emptying one may even see pure, dark red, venous blood dripping out of the resectoscope sheath. These signs will be the more apparent the less the bladder was *overfilled.* Beginners frequently overfill the bladder with the result that irrigating fluid runs into the vein, only to return when the bladder is empty. This effect may be corroborated by examining an open venous sinus under different conditions of bladder filling. If the sinus is kept under view while fluid is drained (particularly easy to achieve by means of the central stopcock on Storz instruments), a few seconds will elapse before blood reappears in the lumen. Earlier and more vigorous hemorrhage occurs if the bladder has been more slowly and only partially distended, e.g., during inspection of the resection field for bleeding points.

An explanation is thus provided for the following phenomenon:

Resection is undertaken with apparently slight blood loss. After removal of the instrument, the catheter then proceeds to yield dark, almost pure blood. What has happened is that at the end of the operation the surgeon unwittingly incised a venous sinus. Since there was little or no arterial bleeding the instrument was removed once the bladder had been filled. The extent of hemorrhage only becomes apparent from the heavily blood-stained irrigating fluid draining down the catheter.

b) Visible Blood in the Resection Field

Bleeding from venous sinuses will only become apparent during operation if the irrigating flow is minimal and the bladder not filled to capacity. Even under these conditions a fountain of blood like that due to arterial bleeders will never be seen: the bleeding far more resembles gentle cloud formation. After all blood does not squirt out of a sinus, it trickles, albeit in a quantity unmistakable under correct observation conditions.

The search for and discovery of venous channels is considerably more difficult than for arteries, since even a slight irrigating jet may be enough to wash blood away and irrigate into the lumen, so rendering the channel invisible. It is thus essential to reduce irrigating flow to an absolute minimum and begin inspection after complete emptying of the bladder. This should be slow and extremely cautious. If the region of a blood cloud is gently approached, blood will be seen to issue in dense streamers. Additional certainty of having discovered a venous sinus may be gained by then increasing the irrigating flow and directing the jet toward the suspicious area. First of all, blood will be washed away, and the venous channels subsequently demonstrated by the entry of irrigating fluid.

c) Inspection of the Resection Field

Experienced operators generally have little difficulty in detecting venous sinuses during inspection of the operative field. The appearance of their slit-like, rather irregular lumen is quite typical. That one is dealing with a venous sinus may be definitely confirmed by observing the channel under gentle irrigation and slow bladder filling.

Generally speaking, venous sinuses are incised toward the end of resection and chiefly when the main bulk of adenoma has already been removed and the capsule is being cleaned of glandular residues. At this stage arterial hemostasis is already so far advanced that the irrigating fluid has only the slightest pink discoloration. Visibility and field of view are therefore excellent within the already virtually empty cavity.

If a venous sinus is incised under these conditions it is usually apparent at the time of opening the channel itself.

4. Closure of Venous Sinuses

The coagulation of venous sinuses succeeds only in *rare individual cases,* mainly due to the extremely tenuous wall of the vessel and the absence of an elastic coat that could be so changed by coagulation as to close the vessel.

Attempts at coagulation usually merely render the lumen of the vessel wider without in any way arresting bleeding, although it is reasonable to attempt to "weld" the edges of smaller vessels together by tangential pressure. Some years back I tried using a conical coagulating probe but once again I was successful in only a few cases. HERTEL (1974) has published a technique which is promising for certain cases, although only the most experienced operators may find it easy to practice. A piece of tissue is resected close to the sinus and placed in the lumen rather like a cork in a bottle. This idea sounds extremely simple but actually harbors considerable technical difficulties, since first requirement is the "customization" of a tissue fragment to fit the lumen. The second difficulty is to then so maneuver the chip into the lumen that it remains there, even while the margins are being coagulated to retain it. Occasionally one succeeds in pressing a pedunculated tissue fragment, still attached by its base, into the aperture. I have succeeded only a few times with this technique and its broader application is doubtlessly hindered by its extreme technical sophistication.

Apart from the above two methods there is *no* instrumental or operative way of closing venous sinuses. Other maneuvers must be undertaken immediately following operation, and these are still to be discussed (see Chap. N).

IV. Final Inspection of Hemostasis

After evacuating all resection material, a further inspection of the operative field must always be made to ensure that complete hemostasis has been achieved. The pumping action involved in evacuating the bladder may, after all, have restarted hemorrhage from some small vessels and even occasionally from a thoroughly coagulated large one.

The quality of hemostasis may be appreciated chiefly from the color of the irrigating fluid. If it is returned from the bladder with merely a pale pink tint one may always assume that hemostasis has been thorough. Whenever, on the other hand, irrigating fluid is returned darker than "red gravy" a further inspection of the operative field is required. It is an absolute rule that *every* *last* arterial vessel must be closed by coagulation. No balloon catheter, whatever its irrigating arrangement, will be capable of arresting arterial hemorrhage. Only accurately placed coagulation will achieve this. Other techniques such as running over the field with a roller or mushroom probe are quite unsuitable.

V. Summary

The preceding sections have given detailed descriptions of individual hemostatic technique. The following is a summary of the fundamental rules:

1. Inspect the operative field under minimal irrigation.
2. Evacuate or scrape away all clots that impede the view.
3. Carefully clean the operative field, if necessary by means of small, smoothing cuts, so as to achieve optimum visibility.
4. Coagulation of veins should only be attempted when all arteries have been closed. Confine this to large veins, since unnecessary necrosis results from an attack on barely perceptible oozing.
5. Make a final inspection of distal and proximal margins of the operative field to be sure nothing is overlooked.
6. If one or more venous sinuses have been detected, an even more careful search must be made for residual arterial bleeders, since the quality of arterial hemostasis can no longer be measured by the color of the irrigating fluid.
7. Never depend on spontaneous or pharmacologic hemostasis or on technical gadgets.

If these rules are carefully observed an uneventful postoperative course may be anticipated.

Chapter G
Transurethral Bladder Surgery

I. Introduction

Nitze was the first to attempt removal of bladder tumors by the endoscopic route. In 1909 Beer undertook the first electrosurgical destruction of a bladder tumor. McCarthy and Alcock were the first to remove tumors of the bladder using a resectoscope. In 1967 Barnes et al. were able to record that 80% of all bladder tumors were better treated endoscopically than by open surgery. Up to the 1950s electrocoagulation remained the treatment of choice for papillary tumors of the bladder in a number of European centers. In the last 20 years American urological practice has had an increasing influence, so that electroresection of bladder tumors is nowadays generally accepted. One principal reason for this shift in emphasis was the uncertain fate of the tumor base following coagulation. Furthermore, resection is considerably less time consuming than coagulation, since the latter often required several sittings to destroy large papillomas. Tumors of this type, up to the size of pigeon or chicken eggs, can nowadays be rapidly removed in a single sitting.

Coagulation only remains justified for extremely small papillomas of less than 1–2 mm diameter, which should first be removed with a small forceps for histologic examination. The base of these tumors may then be destroyed by coagulation. The technique is only briefly mentioned in this text for this reason and since it has already become medical history apart from a few limited applications. Equally, the suction method of Hennig and Lechnier (1932) is now hardly ever practiced, and our younger colleagues have never encountered it.

Resection is the only technique for the treatment of bladder tumors offering potential cure of carcinoma. In addition, it is so much more rapid as to have completely supplanted both coagulation and suction. The limits and suitability of resection in the treatment of bladder carcinoma give rise to continuing controversy. The battle lines are still in flux between those who advocate early cystectomy and those who reserve it for special cases. Some degree of agreement has recently been made possible by an accurate system for grading the malignancy of a tumor and staging its depth of penetration. I hope to show in the ensuing text that correct assessment of the indications and proper technique still allow for some improvement in the results of transurethral surgery.

Laser coagulation, which has seen considerable development in the hands of Schmiedt and Hofstetter and their Munich group remains in its infancy

(HOFSTETTER et al. 1979). It is impossible to say at this present trial stage whether the technique will prove to be superior to resection for the treatment of bladder tumors, or whether it will become an aid to the achievement of greater radicality. So far, there is good evidence for the efficiency of the laser at destroying bladder tumors, so that we have now also begun trials with this new technique which has such numerous advantages beside its single great disadvantage of financial and technical cost.

II. Morbid Anatomy

There can only be reason to hope for a curative result from transurethral resection of a malignant bladder tumor if certain pathologic, anatomical and operative requirements are fulfilled.

The endoscopic method of operation is justified by the several millimeters of muscle coat in the bladder wall, resulting in the technical feasibility of excising a tumor with a surrounding margin of healthy tissue.

The chances of cure following an endoscopic procedure can only be assessed if the tissue fragments are subsequently examined histologically for depth of penetration. The morbid anatomist thus has a key role. His task is made considerably more difficult by not receiving the operative specimen en bloc but in numerous fragments. He can only decide whether the tumor has been excised with a healthy margin, or only incompletely, if he receives the fragments in a suitable directional arrangement or potted separately according to depth. Only if he diagnoses the outer surface of the fragment, or tissue from deeper layers, as being free of tumor can any likelihood of cure be assigned to the operation.

Depth of penetration is easy to assess whenever the tumor has not invaded the bladder wall extensively. The easiest cases are those in which the lamina propria has not been breached and a fairly definite assessment can also be made where early infiltration affects only the most superficial muscle layers, since preservation of a directional arrangement in the specimen or tissue samples from deeper layers will make it plain whether or not there is a tumor-free margin.

An almost insoluble diagnostic problem confronts clinicians and pathologists alike if the muscle coat is extensively infiltrated. It then becomes virtually impossible to differentiate between T_2 and T_{3a} tumors (B_2 and C in the classification of Jewett).

Assessment becomes more clear-cut in cases where either clinical or physical methods (radiology, ultrasound) have suggested perivesical infiltration.

The curative value of a transurethral tumor operation can thus only be assessed when the histology report is available. Nevertheless, an experienced and practiced endoscopic surgeon will make at least a tentative diagnosis at the time of operation, since a large part of intramural operative technique is concerned with the macroscopic distinction between infiltrated and tumor-free

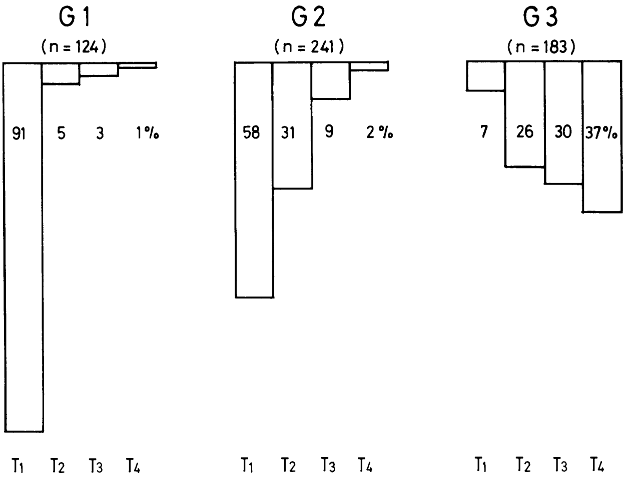

Fig. 193. Malignant grade and penetration depth (in %) for papillary carcinoma (simplified). These numerical data from our own clinic substantiate the well-known clinical impression that well-differentiated papillary carcinomas tend to penetrate less deeply (and vice versa). (From MAUERMAYER et al. 1978)

tissue. Naturally, such distinctions are extremely *rough*, although the suspicion of deeply infiltrating carcinoma can often be confirmed by a carefully placed biopsy in the appropriate area. The excellent magnifying power of endoscopic optical systems has rendered macroscopic diagnosis considerably more certain at the transurethral than by the open route. In the wake of a transurethral tumor resection aimed at cure there may, therefore, arise the requirement either for a further endoscopic operation involving deeper layers of the bladder, or else for a more radical procedure such as partial or total cystectomy. In this light, it is reasonable to look on a proportion of transurethral bladder tumor resections as *excision biopsies*. This remark naturally excludes all those cases in which preoperative investigations have already ruled out the possibility of curative transurethral treatment.

A histologic grading of malignancy or of tumor type is more easily arrived at if an adequate tissue sample is obtained both from the surface and the base of the tumor. The vast majority of bladder tumors are transitional cell carcinomas among which 'true' bladder papillomas are rare. The malignant grade of transitional cell carcinomas correlates to some extent with their depth of penetration in the bladder wall. As shown in abbreviated form in Fig. 193 the depth of penetration increases with malignancy, and vice versa. The vast majority (91%) of all G_I tumors in our practice had not crossed the lamina propria, whereas 95% of all G_{III} tumors belonged to the stages T_2–T_4.

The long-standing clinical experience is thus confirmed that fronded papillary tumors grow mainly toward the bladder lumen whereas sessile undifferentiated tumors have a tendency to early infiltration.

III. Further Aspects of the Assessment and Classification of Bladder Tumors

1. Site Within the Bladder

From a therapeutic point of view, tumors may be divided into those in surgically accessible free parts of the bladder and those arising where the bladder is firmly fixed to surrounding structures. The boundary between these areas is shown by the oblique line in Fig. 194. This question of location within the bladder is of less significance for transurethral treatment than for open surgical approach. The terms 'free' and 'fixed' portions of the bladder derive from the ease of access to the bladder vault and the difficulty in reaching the more fixed basal parts of the bladder. At least two-thirds of all tumors occur in this latter basal area of the bladder (see Fig. 195). The location of a tumor within the bladder will thus influence the preferred therapeutic modality. A G_{II} to G_{III} tumor lying isolated in the vault will be better treated by extensive partial cystectomy (even in an unfit patient). Because of the increased operative risks, tumors of the bladder base of equal or similar grade will tend to be treated transurethrally, all the more since this area is amenable to second look resection including 'controlled perforation.'

2. Tumor Morphology

Under the overall heading of tumor morphology we should consider two anatomical aspects of the growth: its surface structure and its direction of growth.

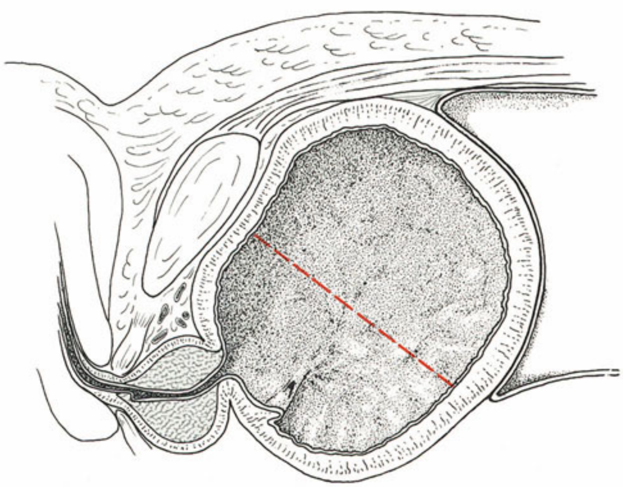

Fig. 194. Free and fixed zones of the bladder. Above the broken line the bladder is mainly covered by peritoneum or loose perivesical fat. Beneath the line it is firmly connected to surrounding structures allowing resection by the correct technique to penetrate deeply into the muscular wall

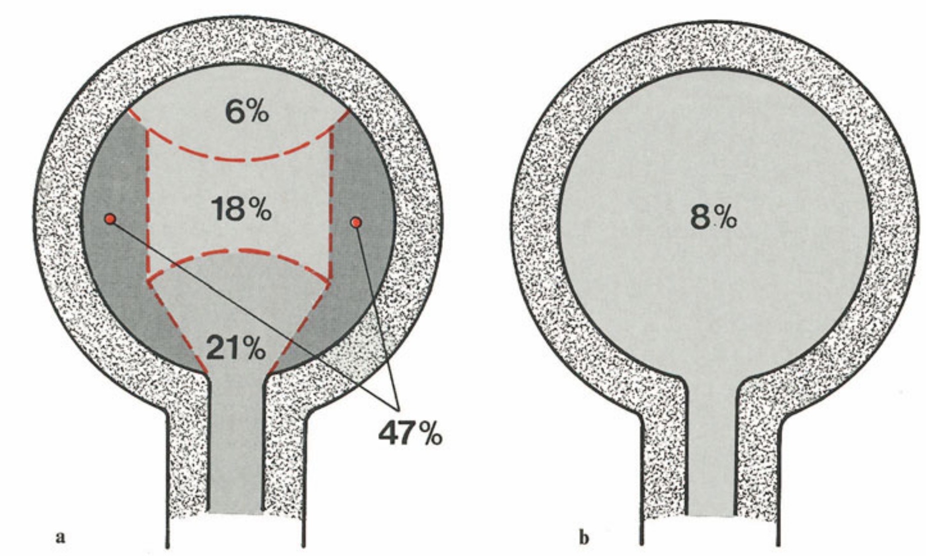

Fig. 195a, b. Percentage distribution of bladder tumors by site in various regions of the bladder. **a** dorsal, **b** ventral. (After Mostofi 1956)

a) Surface Structure

The surface appearance will provide the experienced surgeon with some clue as to whether histology will reveal a well-differentiated papillary or poorly differentiated carcinoma (see Fig. 196). The dominant characteristics are delicacy and pronouncement of the tumor villi. The finer their formation and the more gently they float in the irrigating flow, the more likely they are to belong to a well-differentiated carcinoma. Coarse lobular villi are likely to relate to a higher grade of malignancy. The most malignant development from the basic papillary type consists of a virtually solid growth with an irregular surface, its variations in thickness being the sole remnant of papillary structure (Fig. 197).

Illustrations 64–66 (Plate XI) and 67 (Plate XII) show the appearance of individual types of bladder tumor. The lowest grade was that of the tumor in Illustration 64 whose freely mobile and well-pronounced villi float gently in the irrigating flow (histology: papillary carcinoma G_{I}). The tumor in Illustration 73 (Plate XIII) was of somewhat higher grade malignancy; although its papillary structure remains easily recognizable, individual villi arise in close proximity and are partly united (histology: papillary carcinoma G_{I-II}). The tumor in Illustration 67 is the most malignant: although some papillary structures remain visible in the foreground, a barely organized growth may be seen behind (histology: papillary carcinoma G_{II-III}).

The appearance of solid tumors is quite different. If they arise in basal layers of the epithelium they are often difficult to recognize since they have a macroscopically intact surface and may only be revealed by local rigidity

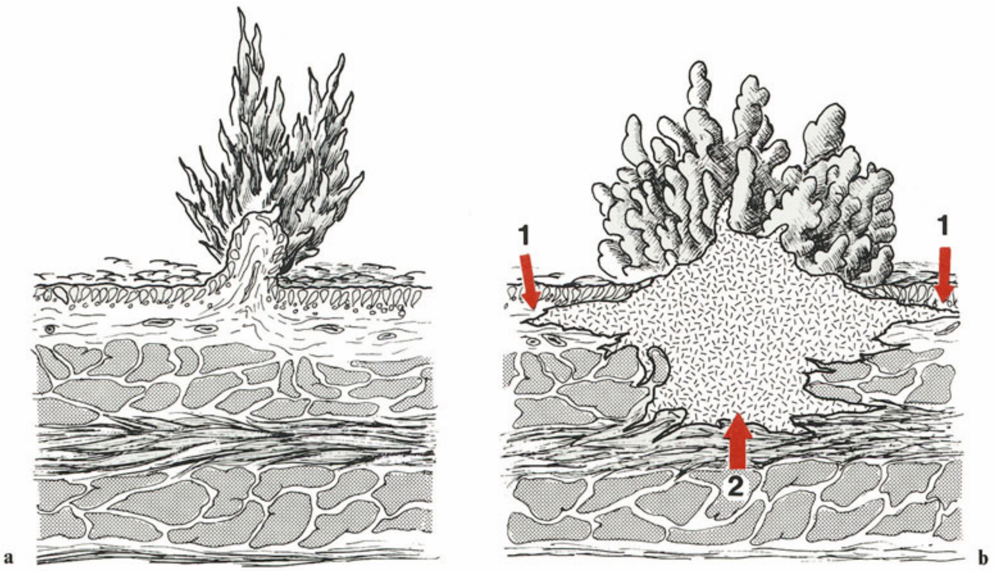

Fig. 196a, b. Diagrammatic representation of typical growth forms for G_I and G_{III} carcinomas. a The fine-structured growth has a mainly exophytic character. Infiltration of deeper layers is only rarely seen. **b** Typical habit of a G_{III} carcinoma. Even quite modest-sized tumors infiltrate the bladder muscle early. **1** Submucous and **2** intramuscular infiltration

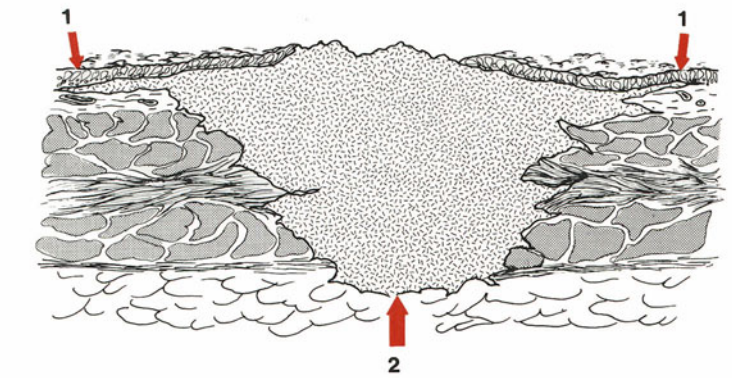

Fig. 197. Growth habit of aggressive, highly malignant tumors such as squamous cell and undifferentiated carcinomas. The endovesical portions of such tumors are often barely visible, while (*1*) submucous and (*2*) intramuscular infiltration predominate. Endoscopic treatment of this type of tumor is only possible in a few exceptional cases

of the bladder wall. With increasing size they tend to rise above the level of the surrounding mucosa, although in the initial stages they will have a flattened, rather unimpressive shape. Their margin is occasionally raised around a central depression, reminding one of a crater, particularly if there is central ulceration. Other types of growth also occur such as the classic ‘cauliflower’ in which small spherical groups of tumors are united in an organized mass. Occasional satellite lesions occur in the vicinity.

Submucous infiltration around the periphery of the growth deserves particular attention. This frequently appears merely as a slight elevation of the mucosa, the latter appearing somewhat rigid during cystoscopy as the bladder fills and empties and as the mucosa is scanned with the irrigating jet of the instrument (dynamic cystoscopy, see p. 298). Such a rigid surrounding was demonstrated for example around the margin of the tumor in Illustration 67.

b) Direction of Growth

Papillary tumors as a group behave in a mainly 'exophytic' way, i.e., they tend to grow toward the lumen of the bladder and fortunately have, early in their natural history, little propensity to infiltrate.

'Iceberg' behavior is certainly the most appropriate description for the way solid tumors grow (see Fig. 198). Their chief bulk is intramural, even when they appear superficially small. They grow not only unidirectionally in depth but also outward around the periphery, even if this is hard to recognize. Not infrequently, these solid growths extend deeply penetrating pegs into the depth of the bladder wall. If the tumor is excised layer by layer, these pegs may eventually be found penetrating perivesical fatty tissue. This phenomenon is without exception highly malignant and markedly limits curability. In the same context, early intralymphatic spread is of great significance.

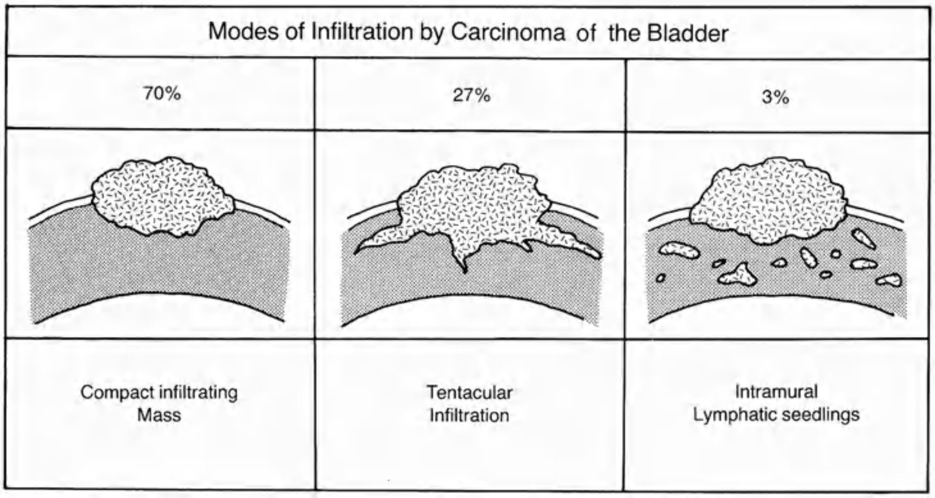
Modes of Infiltration by Carcinoma of the Bladder
70%
27%
3%
Compact infiltrating Mass
Tentacular Infiltration
Intramural Lymphatic seedlings

Fig. 198. Modes of infiltration by carcinoma of the bladder. 70% of all tumors behave as a compact infiltrating mass. 27% send tentacular processes between muscle fiber bundles in the bladder wall, and 3% exhibit early intralymphatic seeding. (After JEWETT 1950)

3. Tumor Size

Once again two aspects need to be considered: the endovesical tumor bulk and diameter at the tumor base.

a) Endovesical Tumor Bulk

Exophytic papillary growths not infrequently achieve extraordinarily voluminous development, occasionally almost filling the bladder. They may be technically difficult to ablate and require considerable endoscopic operating experience. Tissue quantities of 100–200 g and more have been described (REUTER 1963), and we have had similar experiences. Illustration 66 (Plate XI) is representative of such a situation in which the bladder is virtually filled by tumor mass and normal mucosa only visible in a few regions which then form the starting point for endoscopic tumor resection. Carcinomas of this type are frequently treated by excision of the tumor or even by cystectomy, despite the fact that their usually low infiltrating potential makes them eminently suitable for curative endoscopic therapy. Surprisingly enough, the majority of these tumors have little invasive tendency and develop on a narrow base. The endovesical bulk of solid tumors is generally slight.

b) Diameter of the Tumor Base

The base of the tumor is only easily appreciated cystoscopically when no longer covered by exophytic masses.

For solid tumors the base diameter correlates well with the depth of penetration.

The term 'tumor base' cannot be applied to large carpets of papillary neoplasm. The latter are an extensive form of growth arising in a wide area of mucosa.

4. Solitary and Multiple Tumors

Whereas isolated papillary tumors are easily treated, multiple papillomatosis makes considerable demands on the transurethral surgeon. The most difficult situation arises where the bladder contains but a few islands of normal mucosa.

5. Recurrence Rates

The proliferative behavior of the urothelium is immensely variable. Among our patients with recurrent bladder tumors there are some who develop new growths every 6–8 weeks, whereas others remain disease free for many years following a single operation. What is more, this behavior may change suddenly for reasons unknown to us. Patients who were 'regular customers' to our clinic suddenly cease to form further tumors, yet some others whose check cystoscopies had been clear for years suddenly start to have recurrences. This unpredictability of bladder tumors is one of the factors necessitating the repeated assessment of patients at intervals which should be adjusted to their personal recurrence rate. Changes in grade of malignancy are just as unpredictable as the recurrence rate. Patients with previously well-differentiated tumors present, for no apparent reason, poorly differentiated recurrences. We have been unable to find any definite relationship between changes in recurrence rate and in malignancy grade (TAUBER and MAUERMAYER 1979).

On the other hand we concur with RÜBBEN et al. (1978) in the view that sinister changes in malignancy behavior and depth of penetration should lead to an alteration of therapeutic strategy toward a more radical program of treatment.

IV. Assessing the Patient

1. Preliminary Considerations

Preoperative assessment should deal with 4 sets of questions:

1. Where is the tumor located?
2. What is its histologic nature?
3. Is a transurethral or an open surgical approach to be preferred (depth of infiltration, grade, site)?
4. What form of treatment will the patient's condition best allow him to tolerate?

A proportion of this information can be provided by suitable radiologic examination. Endoscopic examination under anesthesia together with bimanual palpation of the true pelvis retains a central position despite all advances in imaging techniques. We hope in future to hear more of ultrasound diagnosis, both external and endovesical.

Wide excision biopsy remains the mainstay of diagnosis and in a proportion of cases is also curative treatment (see the above morbid anatomical aspects, p. 284).

2. History

Taking the case history forms an essential part of any clinical assessment, yet it is of little interest when considering the indications for treatment. Only if a patient complains of long-standing hematuria may one assume a tumor to have been present for a considerable period. Pain in the flank may suggest partial or complete obstruction of a ureter by tumor, and general cachexia will point toward advanced tumor invasion. Painful frequent micturition not infrequently occurs in relation to tumor necrosis and/or infection. Yet all these features of the history are only of value in so far as they arouse suspicion in advance of physical examination and investigation.

3. Radiologic Investigation

The various forms of radiologic examination combine with cystoscopy and bimanual palpation of the bladder to provide the bulk of information on size, extent and type of bladder tumor.

a) Excretion Urogram

The greatest value of this investigation lies in its delineation of the upper urinary tract where, apart from coincidental findings, interest will center on the freedom or obstruction of urine flow to the bladder. Obstruction of one or both kidneys or indeed unilateral nonfunction should always be regarded as of serious prognostic significance. The problem may lie either in obstruction of flow by a tumor adjacent to the ureteric orifice or in infiltration of the bladder base by a distant lesion. Even small solid tumors adjacent to the orifice may interfere partially or completely with urine flow and should be considered to have limited curability, since they frequently have already penetrated the bladder wall in the pre-existing tissue plane along Waldeyer's sheath, thus achieving a T_{3B} stage. Growth *within* the ureter itself (see Illustration 76, Plate XIII) can only be detected by the protrusion of tumor villi from the ureteric orifice, or if at resection of the vesical end of the ureter, tumor infiltration is visible within the lumen.

The bladder shadow is frequently displaced or distorted by filling defects due to tumor. Such filling defects are particularly easy to see if the bladder is only partially filled.

Maximum information may be extracted from this investigative technique by the addition of oblique and after-micturition films.

b) Cystogram

Suspicious areas in the radiologic bladder image seen on IVU may be further investigated by cystogram. Rigidity of the wall due to tumor infiltration can be detected by step cystogram if the patient can be so positioned as to ensure a tangential beam. We only rarely undertake this investigation since it has few advantages over dynamic cystoscopy (see p. 296). The same is true of double contrast cystogram despite the impressive pictures obtained.

c) Cystourethrogram

The extent and degree of infiltration of a tumor adjacent to the internal meatus and related deformity and infiltration of the urethra may be accurately detected and assessed by this method. Its value is purely documentary, since the same findings will be available from endoscopic examination.

d) Pelvic Angiogram

This complicated and invasive technique has failed to provide information which was not available by the far simpler means of endoscopic examination under anesthesia and bimanual palpation of the bladder with full muscle relaxation. Once again, this investigation is only of diagnostic value if the tumor and contrast-filled vessels are shown tangentially. The method fails to provide any useful information on the depth of tumor penetration within the bladder wall. On the other hand, perivesical infiltration is easily visualized, lying as it does within the tangential beam. For these reasons, little is now heard about this technique despite the excitement with which it was hailed a few years ago.

e) Computer Tomogram

This method is excellently suited for the diagnosis of perivesical infiltration. On the other hand, infiltration of the bladder base or vault is less well seen than if it affects the lateral walls. The method is not an aid to early diagnosis but remains an excellent way of documenting extramural perivesical spread. In this respect, computer tomogram is superior to the pelvic angiogram, since areas of bladder wall may be assessed that are hidden to angiogram because they lie out of reach of any possible tangential beam. The method is noninvasive and well tolerated by patients.

f) Lymphangiogram

We do not generally employ this technique during the workup to transurethral operations. Even its value prior to cystectomy is debatable, since first-level lymph nodes of the obturator and internal iliac group are frequently not visualized. Under typical circumstances where TUR of a bladder tumor may be indicated (usually endoscopic clearance of a highly differentiated, noninvasive tumor), the likelihood of positive lymph node metastases is, furthermore, so slight that the diagnostic effort involved is out of all proportion to its benefit for the patient.

If, on the other hand, stepwise resection of a tumor reveals that organ-preserving methods are unable to control the disease, lymphangiogram should be performed for preoperative staging of the tumor prior to radical surgery.

Lymphangiography cannot be repeated, and its application to papillary bladder tumors is, therefore, ruled out in view of the high recurrence rate of the disease.

4. Ultrasound in Diagnosis

Ultrasound is the most recent imaging technique. At the time of completing this manuscript, results were not yet available from large, well-documented series, neither for external nor intraluminal examination (late 1980).

Experience so far (Nakamura and Niijima 1980) suggests that the technique of endovesical bladder wall scanning may be capable of providing good information on depth of penetration.

5. Cystoscopy

a) Preliminary Considerations

Carried out under general anesthesia, with muscle relaxation, and combined with bimanual palpation of the true pelvis, preoperative cystoscopy remains the fundamental and decisive investigation. No other method has been able to replace direct inspection of the diseased organ.

Since anesthesia is essential for this examination, biopsy of the tumor – or even complete ablation of small growths – may and should be undertaken in the same sitting, thus saving the patient a further anesthetic.

b) Diagnostic Cystoscopy

Since examination of the bladder may now be undertaken with a series of telescopes of varying angles of view, the likelihood of overlooking a bladder tumor has become negligible (Fig. 199). Minute papillary proliferation of the mucosa was occasionally invisible to earlier telescopes of poor resolving power.

We always inspect the bladder with a variety of telescopes from the available range of Hopkins systems with viewing angles of 30°, 70° and 120°. The moder-

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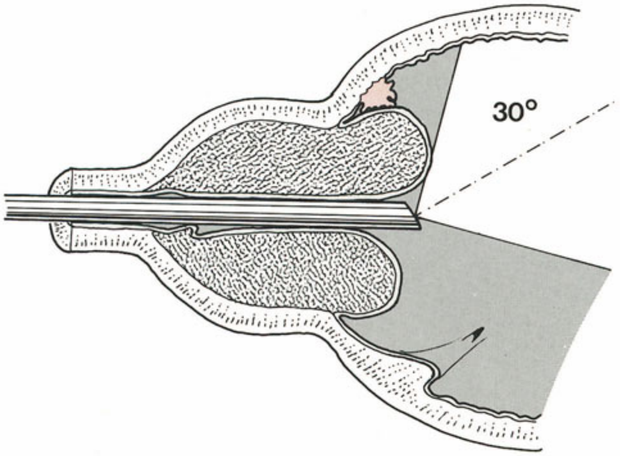
Fig. 199 a–c. Examination of the bladder with telescopes of varying angle of view. a This mainly forward-viewing telescope is well able to visualize large areas of the bladder. However, a tumor in the bladder neck region is obscured from view by an endovesical adenoma. **b** Even a wide-angled 70° telescope is unable to see the tumor in this example, although the field of view comes very much closer to it. **c** Only the 120° retrograde viewing telescope is able to make the diagnosis. This example shows clearly that complete examination of the urinary bladder frequently requires the use of several different telescopes. In particular, inspection of the bladder neck region in the presence of an endovesical prostatic adenoma may require a retrograde system ▷



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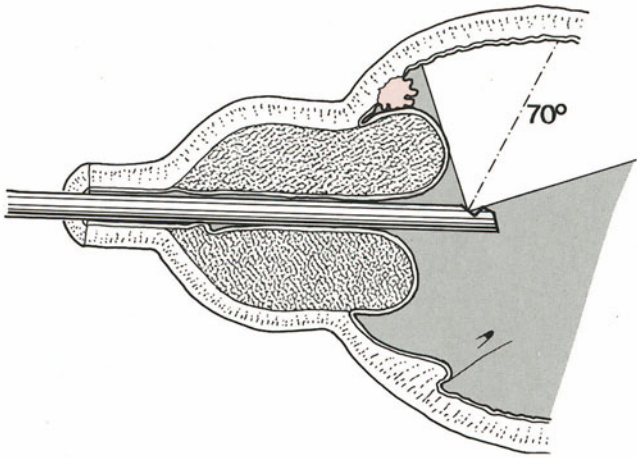

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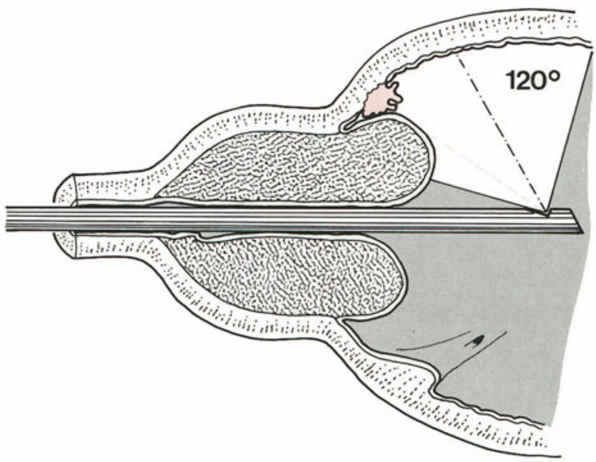

c

ate angulation and enlarged image obtained for a given distance from the object (by comparison to wide-angled systems) make the 30° telescope particularly suitable for the inspection of local detail.

The 70° telescope is intended as a general diagnostic system, and its wide angle of view has a partly retrograde segment if one accepts any field of view beyond a right angle as retrograde.

The 120° system is a truly retrograde-viewing telescope allowing inspection of otherwise invisible regions of the bladder adjacent to the internal meatus, even in the presence of an endovesical bulge of prostatic adenoma.

The use of a variety of telescopes is thus obligatory if all areas of the bladder are to be accurately seen.

Such a requirement is of particular importance in relation to tumors presenting as microscopic hematuria. Unless the mucosa of *all* areas of the bladder and bladder neck has been carefully inspected the bladder should not be pronounced tumor free.

c) Examination of the Internal Meatus

In the male this region can only be properly examined if good anesthesia allows free movement of the instrument in terms both of lateral abduction and of dorsal depression of the eyepiece, so as to visualize the ventral transition from prostatic urethra to bladder vault. Examination of this region is rendered considerably easier by a 120° retrograde-viewing telescope, since the usual wide excursions are then no longer required (see Fig. 199).

This does not, however, solve the problem which will arise at operation, where a 0° or 30° telescope will have to be employed. For this reason, it is usual to start by ablating obstructing areas of the prostate so as to render visible the otherwise blind zone in the immediate vicinity of the internal meatus, whence tumor is then easily removed as necessary. Patients should be informed of this requirement prior to operation.

Illustration 65 (Table XI) demonstrates this situation. A carpet of papillary tumor spreads from the bladder vault down toward the internal meatus and is only visualized by counterpressure on the vault. A small, isolated papillary tumor is visible at the transition from posterior wall to vault.

d) Dynamic Cystoscopy

Cystoscopy is usually undertaken in a static fashion. By this I mean that the bladder is cleared by irrigation and then inspected in a given static state of distension. By contrast, dynamic cystoscopy employs two further factors available with most modern instruments:

1. Examination of the bladder during influx and egress of irrigating fluid.
2. Scanning of the bladder wall with a collimated jet of irrigating fluid. This principle was first realized in the water-jet cystoscope of MAY (1953).

The same principle is employed in step cystogram, a radiologic technique for detecting immobile regions of bladder wall adjacent to tumor.

Cystoscopic examination has the great advantage over radiology that the diseased organ itself can be carefully examined from within and that the surgeon himself receives direct information on the field of the planned operation. This is why we desist from extensive radiologic investigation of the bladder, since the resulting information would still have to be corroborated cystoscopically.

Technique of Dynamic Cystoscopy

1. Examination of the bladder under varying conditions of filling.

   The basic principle is simple. The bladder is examined as irrigating fluid runs in and drains away, the instrument being somewhat retracted during drainage so as not to interfere with the process. Certain areas of the bladder, e.g., the vault, but also regions of the lateral wall, are better seen when the bladder is not overfilled. Furthermore, the vault of a partially filled bladder is more easily visualized with counterpressure from above. The mechanism of 'kissing' metastasis from a tumor on the opposite side of the bladder will then be easily appreciated. Rigidity of the bladder wall around the periphery of a tumor may also be demonstrated. Only thus may the true extent of a tumor in the submucous and intramural plane be detected optically. Regions of the bladder normally hidden to inspection, e.g. the bladder vault in the presence of an endovesically extensive adenoma, are more easily offered up to the telescope by external pressure (Figs. 200 and 201).
2. Examination by scanning of the bladder wall with the irrigating jet.

   A collimated irrigating jet enables the bladder wall to be palpated from within. With the bladder only moderately filled, it may be seen how soft areas bulge away while tough, infiltrated zones remain rigid and immobile. This *internal palpation* of the bladder allows the detection of submucous infiltration even where the mucosa itself appears innocent (Fig. 202).

e) Examination of the Ureteric Orifices

Whenever a tumor occurs in the vicinity of the lower ureter, the orifice itself should be carefully identified prior to surgery. If a papillary tumor lies close to the orifice, the latter may be demonstrated by washing away the villi. Some models of resectoscope will accept an operating element allowing catheterization of the ureters. A ureteric catheter can then be placed within the ureter and left there during surgery if the instrument is withdrawn and reintroduced beside the catheter. The landmark thus provided is frequently useful.

The same device may be used either diagnostically or for urinary drainage at the end of resection when the ureteric orifice has been dissected clear. If a dense carpet of papilloma covers the orifice, indigo carmine should be injected in an attempt to detect the point whence the blue dye issues. Infiltrating carcinomas frequently render such efforts pointless, since intravenous urogram will

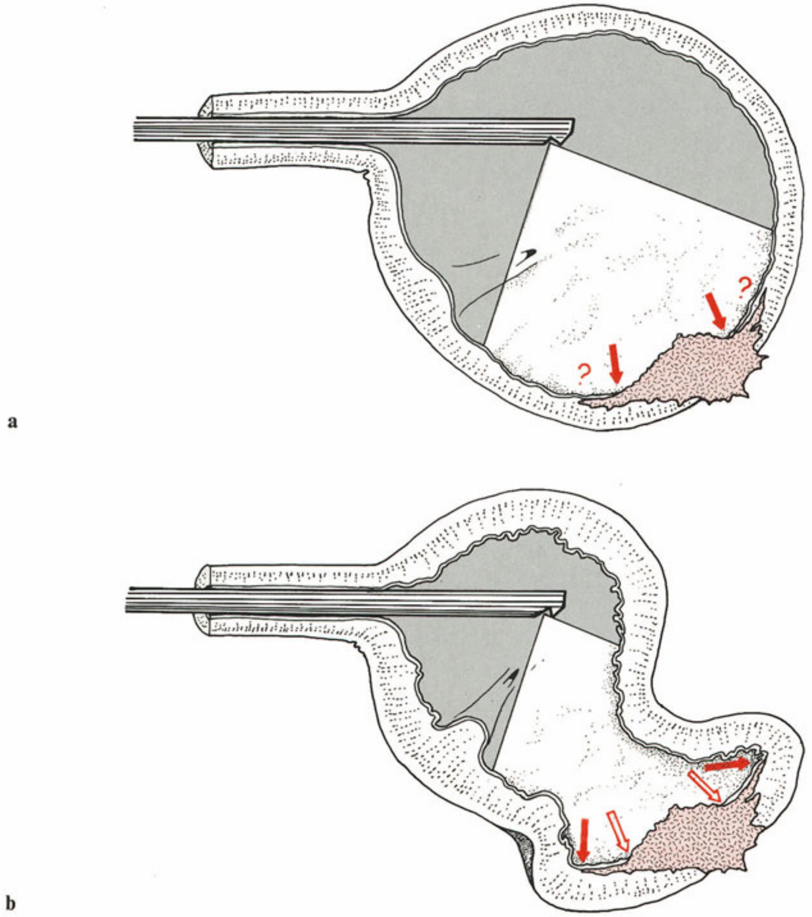

Fig. 200 a, b. Dynamic cystoscopy: detection of tumor infiltration by observation of the bladder wall under different filling conditions. a With the bladder tensely full, rigidity in one area of the bladder wall goes unnoticed. Only the exophytic part of the tumor is visible. **b** As the bladder slowly empties the region rendered rigid by submucous and intramural infiltration becomes more obvious. The same principal applies to examination of the bladder wall by step cystography. Cystoscopic examination however is of greater value to an endoscopic surgeon, since it provides additional data for subsequent surgery to the diseased organ

already have revealed ureteric obstruction or nonfunction of the kidney. Occasionally, small villi of papilloma may be seen protruding from the orifice itself and they are rendered more obvious by a bolus of urine. Alternatively, the orifice may be 'inflated' with the irrigating jet and this occasionally reveals such papillary growths.

f) Determining the Size of the Tumor Base

The surface appearance of the tumor has already been mentioned. It remains here to discuss methods for determining the size of its base. This value has

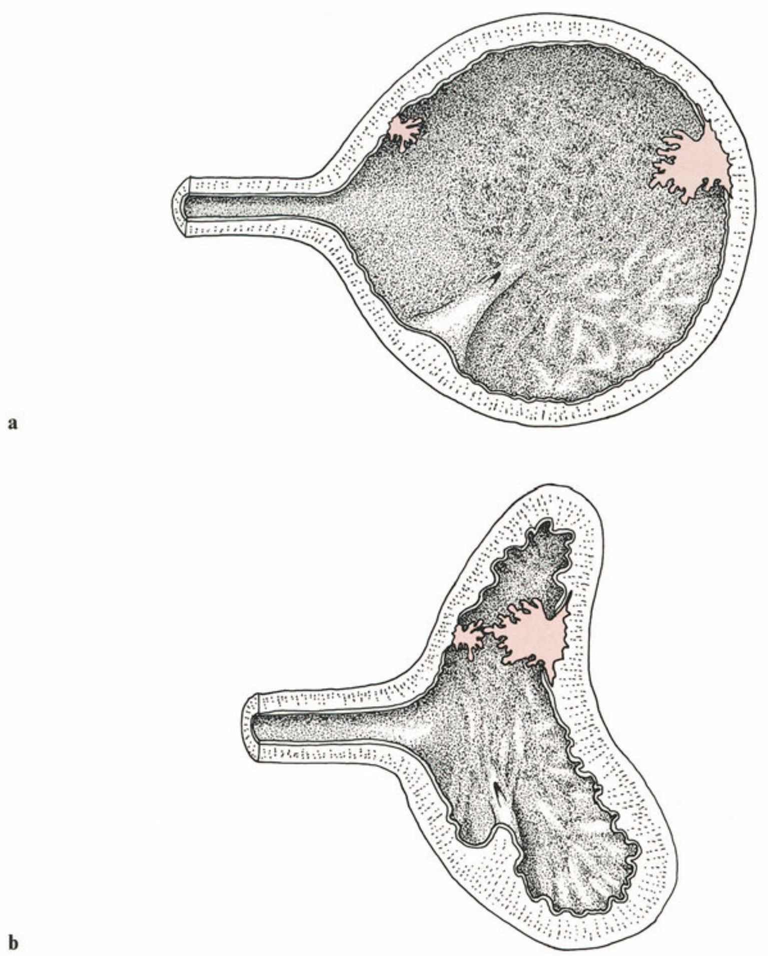

Fig. 201 a, b. Dynamic cystoscopy: inspection of the full and empty bladder. a Appearance of the full bladder. It is easy to miss the small tumor on the anterior wall of the bladder adjacent to the bladder neck at a superficial inspection and if the examiner is mesmerised by the impressive tumor on the posterior wall. **b** As the bladder empties the large tumor approaches the anterior wall. In fact, both tumors touch. This may lead to discovery of the smaller tumor as well as providing a possible explanation for some types of implantation metastasis

a clinical significance in relation to infiltrating carcinomas whose depth of penetration may thus be estimated. The experienced examiner will have no difficulty in this determination while the beginner may wish to make use of a ureteric catheter with a centimeter scale. This can be advanced into the bladder and angulated to lie across the bladder wall beside the tumor. In our experience, solid tumors with a base diameter of greater than 1 cm have already infiltrated the muscle coat and should be regarded at least as T_2–T_{3B} tumors, if not as stage C.

Stepwise resection in individual layers (extended excision biopsy) will then be strongly indicated.

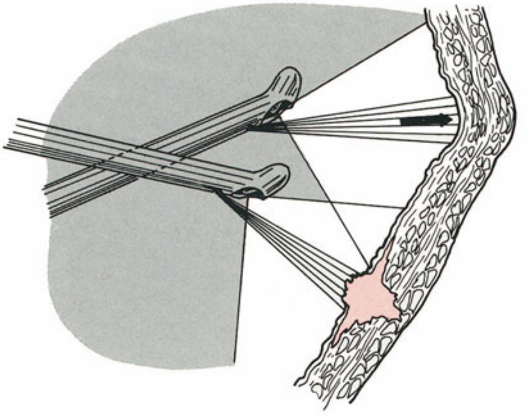

Fig. 202. Dynamic cystoscopy: scanning the bladder wall with the irrigating jet. In the *upper part* of the figure it may be seen how the bladder wall is gently impressed by the irrigating jet. *Below*, note the rigidity of the infiltrated wall

The situation is different with papillary tumors whose low infiltrating potential we have already mentioned. Conversely, measurement of their base diameter is often difficult, since clouds of tumor villi tend to overhang. Once again, the rule holds good that broad-based tumors of this type are likely to be more malignant and more deeply infiltrating than those on a thin stalk (fine tumor carpets are an exception to this rule).

g) Examination of Diverticula

A bladder diverticulum frequently contains tumor *invisible* to superficial examination. This preference of tumors for diverticular mucosa must surely arise from the increased contact time of suspected carcinogens in the urine with the mucosa. The increased frequency of tumors of the bladder base is also often mentioned in support of this causal theory (KNAPPENBERGER et al. 1960; GÖBEL 1966).

Cystoscopy should, therefore, never be terminated without inspection of the diverticulum or diverticula. Occasionally, a minute villus of papilloma may be seen protruding from the mouth or over the margin of a diverticulum, providing a clue that tumor lies within. If the opening into the bladder is narrow it may have to be *incised* endoscopically at one or more points until it is wide enough to accept the instrument and allow it adequate freedom of movement. This is the only protection against missing tumors within diverticula, which constitute 7% of the overall frequency.

Illustration 78 (Plate XIII) demonstrates the results of resecting a bladder tumor on the margin of and within a diverticulum. The diverticular orifice was widened at operation by incision and the portions of tumor within the diverticulum were then removed. Subsequent cicatrization has somewhat narrowed the diverticular orifice again.

h) Vaginal (Rectal) Palpation During Cystoscopy

A combination of cystoscopy and palpatory exploration of the bladder base in a single examination is sometimes informative, e.g., when a region of infiltration is seen on the base of the bladder. It may then be possible to decide whether one is dealing with an inflammatory or neoplastic change. Biopsy, particularly of deeper layers, is more easily carried out if combined with vaginal (rectal) palpation. The same combination may be of use in elucidating the converse situation, where vaginal (rectal) thickening is felt, and one wishes to know which area of the bladder base it is related to.

6. Bladder Biopsies

Since, for the above reasons, diagnostic cystoscopy should always be undertaken under anesthesia, biopsy may be carried out at the same time. Two methods are available.

a) Biopsy by Endoscopic Forceps

If the initial examination is by cystoscope rather than resectoscope, the viewing element should be exchanged for an endoscopic biopsy forceps. The largest possible tissue samples are obtained from the surface and base of the tumor and fixed in formalin. This maneuver may be quite difficult in some regions of the bladder, e.g., around the internal meatus. Difficulty may also arise in the vault. The biopsy forceps have the disadvantage that subsequent hemorrhage may require further work with a coagulating probe. Tissue fragments thus obtained are considerably smaller than those available by excision with the resectoscope loop. The tumor base can only be excised with considerable difficulty by the forceps.

b) Resectoscope Biopsy

We prefer to inspect the tumor with a resectoscope. Because of the wide variety of available inserts and telescopes this brings no disadvantages of thoroughness or visibility. Biopsy is then undertaken with an electrotome inserted in place of the diagnostic telescope. Since the majority of our patients undergo this examination under anesthesia with a pre-existing diagnosis of bladder tumor, we are able to combine a thorough preoperative cystoscopy with tumor resection. Not only is the patient thus spared an additional anesthetic, but his stay in hospital is also considerably shortened.

It is then also possible to resect areas of prostate and widen the internal meatus as required for better visualization of concealed regions of the bladder, as discussed above. Diverticular orifices may be incised at the same sitting. The patient should, therefore, be completely prepared and informed of all possible consequences of the procedure.

Naturally, surgery is undertaken in our transurethral operating room.

If it is planned to follow on with resection immediately after examination under anesthesia, bimanual palpation is carried out prior to tumor ablation; if only biopsy is planned, palpation concludes the procedure.

Forceps biopsy is sometimes followed by persistent trickling hemorrhage. We therefore, advise careful hemostasis with a coagulating probe and inspection of the result with irrigation fully turned off. If proper hemostasis cannot be achieved in a villous tumor, it may be better to proceed directly to its complete removal or to pass an indwelling catheter with closed irrigation for 12–24 h, despite the minor nature of the procedure.

7. Bimanual Examination Under Anesthesia

The desired information will only be gained if the patient is fully relaxed (Fig. 203). In the male, examination is via the rectum, just as for the prostate.

Tumors of the *bladder base* are palpated for separability from or fixation to the prostate. Unless the patient is excessively obese, these bladder base infiltrations are easily palpable above the prostate.

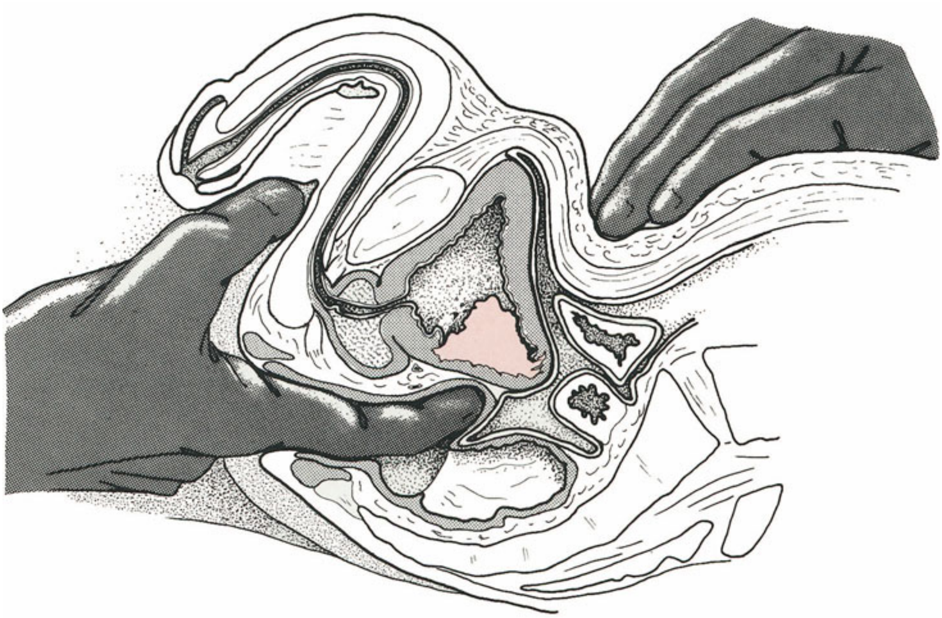

Fig. 203. Bimanual examination under anesthesia. Rectoabdominal (vaginoabdominal in the female) bimanual palpation gives valuable information on the degree of infiltration of a tumor. Complete muscle relaxation is required

Tumors of the *lateral bladder wall* are easily palpable between two hands and their size may be estimated by rolling them between the fingertips. Their mobility may be examined by attempting to move them from side to side. Perivesical infiltration fixing the bladder to the lateral pelvic wall will be equally palpable by the same token as infiltrations of the fascial sheath, described by JEWETT (1950) as the 'inferolateral ligament,' palpable only if infiltrated by tumor.

MARSHALL (1952) reports an exceptionally firm correlation (81%) between the presence of palpable induration on bimanual examination, persisting after transurethral resection, and the presence of a deeply infiltrating tumor (stage B_2 and C) rather than a superficial one (A or B_1).

Bimanual examination yields particularly impressive results for primarily infiltrating carcinomas where the cystoscopic finding is merely one of a flat ulcerating tumor. Yet palpation may reveal extensive perivesical infiltration. By revealing deep penetration of the tumor and fixation of the bladder, bimanual examination may, therefore, save the patient a trial of excision or a frustrated attempt at partial resection.

V. Operating on Bladder Tumors

1. Preliminary Considerations

The simplicity of the technique may occasionally seduce some surgeons into coagulating 'bladder papillomas' in their consulting rooms. No doubt, this procedure has certain closely defined indications, which will be discussed later. Generally, however, the removal of a bladder tumor is an operation requiring careful preparation of the patient, availability of an operating room and access to its entire range of instruments. Unfortunately, patients repeatedly appear in our clinic having been 'burnt' several times by their urologist in his own rooms without any impression having been made on the tumor base. A further factor militates against such outpatient treatment: following coagulation of a 'papilloma,' all possibility of histologic classification is lost. However small a tumor, therefore, it should always be excised. This may be possible under local anesthesia on an outpatient basis.

For small tumors, the duration of inpatient stay is usually only 1, maximally 3 days. The procedure can then be performed under aseptic conditions in an operating room.

2. Coagulation of Bladder Tumors

a) Preliminary Considerations

At the time of my training in the mid 1950s, this was the method of choice. Large 'papillomas' had to be removed in several sittings with a coagulating

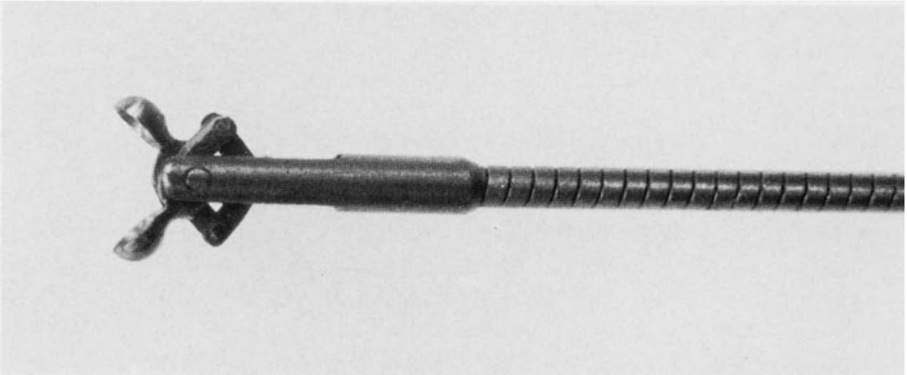

Fig. 204. Miniaturized biopsy forceps for diagnostic cystoscopes. Such a biopsy forceps of only 5-Ch diameter is even available for the 15.5-Ch instrument we use. Thus biopsies of small tumors may be carried out through fine caliber instruments. This is the prerequisite for coagulating small recurrences, which should not be treated without histologic diagnosis

probe, frequently under poor visibility since the limited irrigating power of operating cystoscopes was at that time quite inadequate to maintain visibility once hemorrhage occurred.

If I repeatedly place the word ‘papilloma’ in quotation marks this has a good reason. True papillomas are a much less common form of tumor than one usually imagines. The majority of so-called papillomas are already early carcinomas. Their true nature can, therefore, only be recognized if an adequate fragment is available for histologic investigation. Precisely this is rendered impossible if small papillomas are coagulated, unless of course coagulation is preceded by forceps biopsy of the tumor, the wound in the bladder then being coagulated for hemostasis. Frequently recurring tumors are the very ones with a tendency to increase their grade of malignancy, and this seems to me to represent a further hazard of ‘automatic’ coagulation. A small pea-sized papilloma is seen at check cystoscopy and is immediately coagulated so as to save the patient hospital admission. In all likelihood, viable proliferative cells will be left behind.

Coagulation should, therefore, be restricted to a few exceptional cases. Only small, really finely villous tumors of truly papillomatous appearance should be destroyed by coagulation. The limit lies at a diameter of 1–3 mm, and even here flexible biopsy forceps should be used to remove a small piece for histology, since this represents no additional burden on the patient. For this purpose, we use a forceps capable of passing the 5-Ch operating channel of diagnostic instruments (Fig. 204).

b) Technique of Coagulation

The technique of coagulating these small tumors is simple. The probe is brought into contact with the tumor and coagulating current applied by the footswitch. Repeated dabbing at its surface will destroy the tumor down to its base within

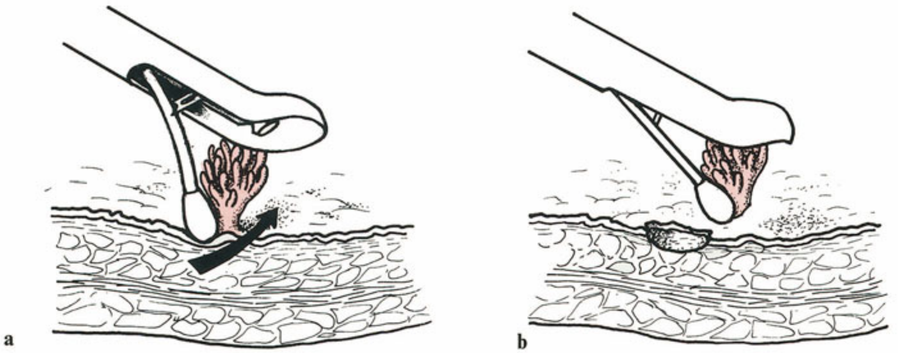

Fig. 205a, b. Technique of coagulating small papillomas. a The coagulating probe is laid against the base of a small papillary tumor and cutting current applied. **b** A wiping movement pushes the small tumor off the base of its stalk. This base will require further thorough coagulation with a small button probe

a few minutes, the tissue turning progressively white and being partly disintegrated by the current into fine flakes. The tumor base itself should then be exposed to prolonged coagulation. Previous current has compacted the tissue and crusted its surface, thus markedly reducing conductivity. This is one reason why tumor cells may survive in the base of a papilloma. Toward the end of the procedure, if I ever perform it, I employ a small 5-Ch probe giving increased current density. This enables me to destroy the stalk below the level of the surrounding bladder. The method of 'wiping off' is considerably simpler and more rapid. The probe is applied straight to the base of the papilloma and *cutting current* (not coagulating) used to divide the stalk and thus wipe away the tumor in toto (Fig. 205). This maneuver is frequently successful in thin stalked tumors. The growth is then evacuated and its base further coagulated, this time with a somewhat wider probe.

It has been our practice to follow coagulation of bladder papillomas with the instillation of 1% silver nitrate solution into the bladder, where it is left for 5 min and then cleared by irrigation with physiologic saline. The effect of this therapy has never been proven, but it is based on the concept that some cells may have survived coagulation without devitalization and may thus be capable of giving rise to new papillomas. I have never seen adverse effects from this additional treatment, but I am quite unable to prove whether my belief in it is justified.

c) Local Anesthesia for Coagulation and Small Resections

Under some circumstances, local anesthetic techniques may be suitable. Certain requirements must be fulfilled:

1. The histologic diagnosis must be known or else secured by biopsy prior to coagulation.
2. A papillary tumor should be small and have a thin stalk.

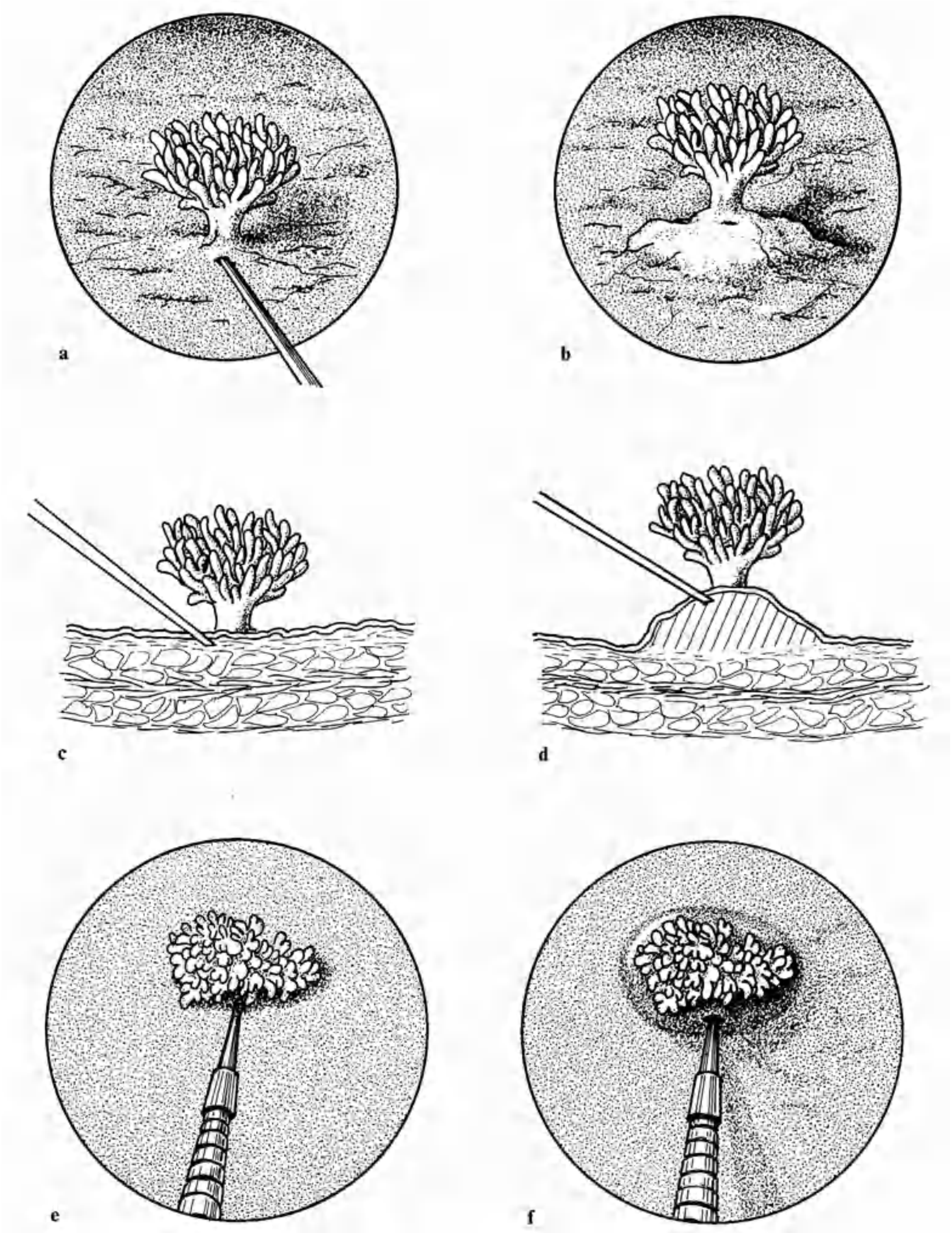

Fig. 206a–f. Technique of local anesthesia for small papillary tumors. a, c Inserting the injection needle at the base of the tumor. **b, d** Injection of local anesthetic lifts the tumor above bladder level to form a small hillock. This facilitates its removal, even with a resectoscope loop. **e, f** The same technique in relation to a small carpet tumor. Once again, local anesthesia can be employed without difficulty, although it may be necessary to inject in several places

3. The tumor should be within easy reach of the endoscope. Growths on the bladder vault or close to the internal meatus are unsuitable because of the wide excursions of the instrument needed during surgery. The latter are frequently more painful than the operation itself.

The candidates are frequently patients whose recurrent tumors repeatedly have the same appearance and in whom previous examinations have always revealed the same degree of histologic differentiation (true papillomas or G_I tumors).

Local anesthesia is simple (see Fig. 206). An endoscopic needle is used to inject 1%–2% novocaine or scandicaine solution under the mucosa close to the base of the tumor, but *well clear* of its visible extent, so as to raise a bleb of a few milliliters. During injection submucous edema may be seen to raise up the tumor. Coagulation should then commence immediately. For these small tumors, I use the finest possible probe so as to achieve the greatest in-depth effect. Once the surface is completely destroyed, I further coagulate the center of the stalk with additional pressure on the probe. This can be done without any fear of perforation, since the liquid bleb under the tumor has adequately separated the site of operation from the deep tissues.

Under the above circumstances, coagulation under local anesthesia on an outpatient basis is entirely acceptable.

Resection under local anesthesia is equally possible if the tumor is in a region easily accessible to the instrument, i.e., mainly on the bladder base. Local anesthesia is induced in the same fashion as described above for coagulation. Resection, however, requires considerable care. Before starting to cut, one should test for the completeness of anesthesia using *coagulating* current in order to prevent uncontrolled involuntary movement on the part of the patient. Only after this check should the tumor be excised in the usual fashion with the cutting loop. It goes without saying that the indications for this procedure are extremely limited. It should be reserved for small tumors on the base of the bladder and undertaken with an instrument of the smallest possible diameter, since large caliber instruments cannot be introduced in the male without pain or at least considerable discomfort. We have achieved good results with the new resectoscope after ENGBERG of only 20-Ch diameter (ENGBERG 1980, personal communication).

The minor nature of the procedure allows it to be performed on an outpatient basis. Coagulation under local anesthesia is painless, the only discomfort being due to movement of the instrument within the urethra. The prophylactic administration of antibiotics is unnecessary with good surgical technique.

d) Healing After Coagulation

In the days when larger papillomas were treated by coagulation the stalk would occasionally be sloughed and urinated out or in rare cases become encrusted and form the nucleus of a phosphatic calculus. Similar encrustations of necrotic tissue are sometimes seen following resection but are usually passed spontaneously. Small papilloma wounds heal so well within a few weeks that the scar can only be detected as a whitish area on most careful inspection of the mucosa. Coagulation of large papillomas and resection of bladder tumors alike will give rise to a radiate whitish scar which is poorly vascularized. It is rare to find recurrences within this scar.

3. Electroresection of Bladder Tumors

a) Preliminary Considerations

It was probably ALCOCK who first removed a bladder tumor by electroresection rather than coagulation. This method has now become the general rule, since the operation is considerably simpler and more radical, once the technique has been mastered. Large tumors and papillomatosis of the bladder may equally be controlled by resection, although the danger of perforating the bladder is undeniably greater than with coagulation.

Since the operative technique for papillomas and carcinomas differs only in the depth to which carcinoma tissue must be traced within the bladder musculature, I have not subdivided the discussion into separate sections on papilloma and carcinoma. Indications and technique of resection in relation to bladder carcinoma will be discussed along with controlled perforation and resection within the deeper layers of bladder musculature.

b) Anesthesia for the Resection of Bladder Tumors

Quite apart from local techniques, as described above, regional (lumbar, epidural) or general anesthesia may be employed. For many years we preferred intubation and muscle relaxation, hoping thus to prevent muscle contractions due to stimulation of the obturator nerve. High-frequency cutting current tends to initiate such sudden and forceful jerks during surgery on the lateral wall of the bladder.

According to FLACHENECKER (1978), these faradic stimulating currents arise by the rectification of high-frequency current (itself *incapable* of nerve stimulation) in the arc burning between cutting loop and tissue, thus exposing the obturator nerve to dc components. Among the many muscles receiving a motor supply from this nerve, it is chiefly the adductors and the obturator externus that give rise to the much-feared twitches. Since the lateral wall of the bladder is in close proximity to the obturator nerve, stimulation may occur whenever high-frequency current is employed in this vicinity. The hopes placed by ourselves and others in the effect of muscle relaxants have unfortunately not borne fruit (HOBIKA and CLARKE 1961). From the point of view of avoiding such contractions, it is, therefore, of no import whether regional or general anesthesia are employed.

c) Methods of Avoiding Obturator Stimulation

The only certain way to avoid such muscle contraction is to interrupt nerve conduction by local block. Various techniques have been suggested:

1. Injection by a perineal approach (CREVY 1969)
2. Injection through the obturator foramen, a routine technique in local anesthesia

Good results have been reported for both methods. I would attach importance to testing the completeness of nerve block, as advocated by TAUBER et al. (in press) by means of a measuring probe. One will otherwise find oneself working with a false sense of security in a region where muscle contractions may still be initiated and be completely surprised by a muscle contraction due to failure of the block.

All other techniques, such as the use of spark gap current, continuous nerve stimulation prior to resection or the use of high doses of muscle relaxant are not guaranteed to be effective. By the present state of our knowledge, local anesthesia of the obturator nerve should be regarded as the most effective technique.

d) High-Frequency Current for the Resection of Bladder Tumors

We use the same apparatus as for prostatic resections but reduce the cutting current as far as possible so as to avoid initiating muscle contractions (seen with vacuum tube and solid-state generators alike) in the lateral wall regions of the bladder. Strangely enough, muscle contractions are considerably less frequent if cutting is by means of the spark gap generator actually intended for coagulation. Modern diathermies do not employ a spark gap and their coagulating current has too poor a cutting power to be useful for surgical dissection.

The instrument designed by FLACHENECKER (1979, personal communication) may bring some improvement since an integrated control circuit allows one to work with minimal current intensity, giving rise only to rare and weak contractions.

e) Instruments for Resection of Bladder Tumors

We use the same resectoscope as we employ for prostatic surgery, i.e., a 24-Ch instrument. Patients having frequent recurrences and therefore needing frequent follow-up examinations benefit from the use of a 22- or 20-Ch resectoscope because of the reduced likelihood of urethral trauma.

ENGBERG (1980, personal communication) has developed an instrument mainly for the treatment of tumor recurrences and satisfying all these requirements. Its diameter is only 20-Ch, its irrigating power is more than adequate and it has an operating channel able to accept a needle for local anesthesia.

The cutting loop should also be of thinner gauge than for prostatic resection so as to cut more sharply with lower current intensities. We frequently resect bladder tumors using cutting loops eroded during a number of previous prostatic resections. The wire has been consumed along the central portion of the loop, thus rendering them extremely fine. Such loops are stored in special containers and reserved for the present purpose.

4. Technique of Bladder Tumor Resection

a) Horizontal Approach

The simplest case will be the removal of a solitary papillary tumor on the bladder base at a safe distance from the ureteric orifices. The technique to be employed in such cases is the one most easily explained and most suitable to be practiced by a beginner under supervision. By analogy to the NESBIT (1943) technique of resection, the tumor is ablated in layers from above downward (Fig. 207a), avoiding subdivision of the tumor by any excessively deep cut (horizontal technique) (see also SCHMIDT and ANWAR 1979).

b) Vertical Approach

A second possible technique is to ablate the tissue from above downward along one margin of the tumor (Fig. 207b), then proceeding to an adjacent portion until the whole tumor has been removed to the level of the bladder mucosa (vertical approach).

We tend to use the first method, the horizontal approach, for more or less spherical tumors extending mainly upward toward the lumen of the bladder. A vertical approach is recommended for broadly extensive growths.

c) Dividing the Stalk

A third technique consists of dividing the stalk of small tumors and then evacuating the main growth in one piece (Fig. 207c).

In practice, one will tend to instinctively combine all three methods into a single fluid process rather than systematically dividing them.

Very large, overhanging 'mushroom' tumors may be resected in quite large pieces if individual cuts are placed from above downward toward the side of the stalk. Because of their great flexibility there is rarely any difficulty in evacuating these tissue lumps. They are easily moulded.

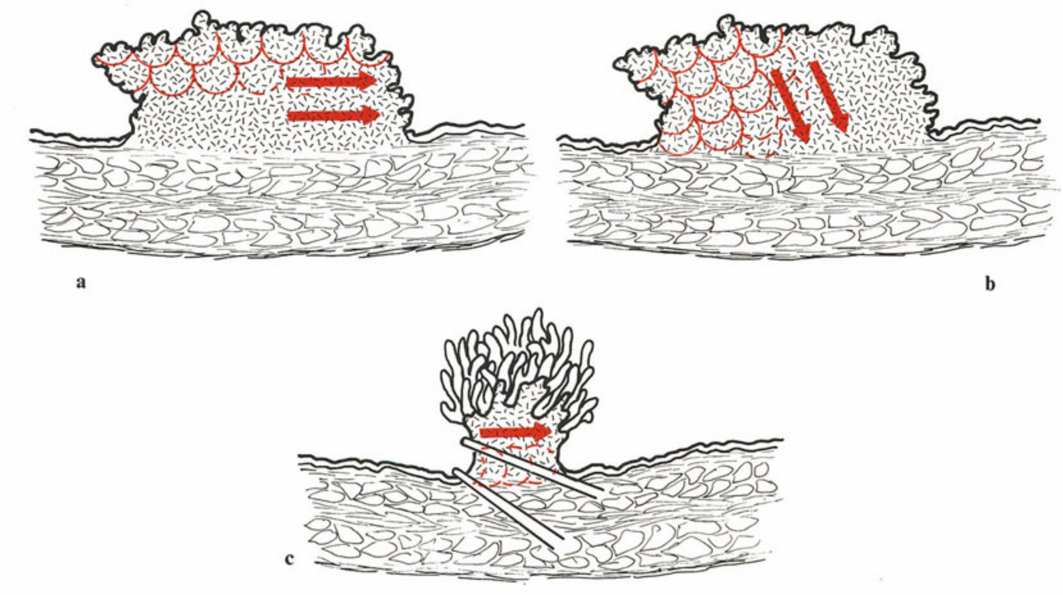

Fig. 207 a–c. Principal forms of operative technique. a Horizontal approach. The tumor is ablated from its surface downwards in successive layers until the base is reached. This technique is suitable for medium large tumors that are easily visualized. In this type of resection blood vessels cannot be coagulated until the tumor has been completely removed, since coagulation will be unsuccessful in the soft tumor tissue. **b** Ablation in a radial direction. This is the typical approach to large tumors, the margin of which is not easy to see endoscopically. After removal of each individual segment careful hemostasis is carried out at the base of the tumor. It is occasionally difficult to maintain orientation during this technique, since residual tumor floats into the way. **c** Ablation of a large tumor at its stalk. Easily visualized tumors with a pronounced stalk can be removed very much more rapidly if the stalk is divided at the level of the surrounding mucosa by a series of cuts. The evacuation even of large fragments becomes simple employing a glass syringe with a metal piston and attached in an airtight fashion to the sheath

d) The Resection of Large Exophytic Growths

This operation makes considerable technical demands on the transurethral surgeon. It should, therefore, only be undertaken by those with appropriate experience. On preoperative examination, the situation within the bladder is often so difficult to visualize and so unclear that doubts arise as to the resectability per se of the main tumor bulk by the endoscopic route. Only full distension of the bladder will finally reveal a zone of intact unchanged mucosa. The appearance is particularly impressive in cases where tumor masses bulge into the field of view immediately around the internal meatus (see Illustrations 66, Plate XI, and 17, Plate III). The basic rules for all such cases are as follows:

1. Start operating at one place at a time. Wherever tissue ablation is commenced – where is frequently immaterial – the operation should be continued. The first step is to make room for movements of the loop as surgery progresses.

2. Operation should continue where it was begun until resection reaches the base of the tumor.
3. The experienced surgeon will tell from the appearance of the tumor villi that he is approaching the base – they become progressively less organized. Shallower slices should be taken in this region.
4. Shallow cuts are used to smooth the base and are immediately followed by careful hemostasis.
5. Once such a free zone has been created, it forms a starting point from which to clear a further area of the bladder.
6. If the tumor partly or completely involves the internal meatus this region should be cleared first, since orientation is easy at the transition to normal mucosa in the bladder neck. The internal meatus is best exposed in a segmental fasion starting on the surface of the tumor and working toward its base. Only when one segment is complete should a second one be attacked.
7. If a tumor stalk comes into view one should not hesitate to divide it, even if this means creating a large, free floating tumor mass within the bladder. It is nearly always easy to evacuate.
8. Fragments of tumor growing on the ventral aspect of the bladder will sink down into the bladder base and create the impression of further tumor in that region. Regular evacuation of resection debris with a glass pistoned syringe is required. *Only such syringes* create enough suction to draw large tumor fragments through the resectoscope sheath. Evacuators of the Ellik type are too weak.
9. Tumor masses on the vault are often easier to excise if an assistant presses down on the abdominal wall. Muscle relaxation is required.
10. In some regions of the bladder wall a scythe loop is useful. To accelerate the changeover from normal to scythe loop and back, have 2 electrotomes ready, each fitted with a different loop.
11. After 1-h operating time, final hemostasis should be commenced and continued until the irrigating fluid returns with only the merest pink discoloration. Reactionary hemorrhage is often difficult to control under the poor visibility in the operative field.
12. If the procedure cannot be concluded within an hour it is better to consider a second sitting.

Such rules can naturally never replace years of experience, but they may nevertheless provide helpful suggestions in a variety of situations.

A well-practiced surgeon can easily remove 100–150 g of tumor tissue within the hour, more under favorable conditions. Mere exophytic extent is *not* an indication for any well-trained transurethral surgeon to open the bladder suprapubically and remove the tumor by that route.

e) Hemostasis

The smaller the tumor, the more one may defer hemostasis until the tumor is completely removed and the supplying vessels easily seen at its base. With

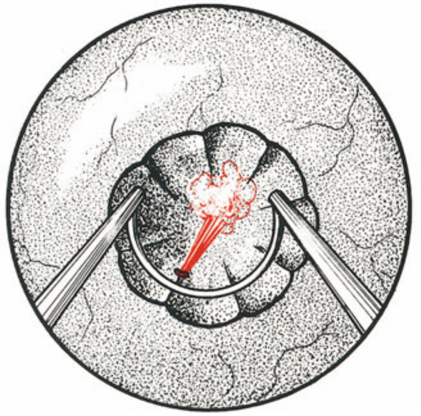

Fig. 208. Diagrammatic representation of hemostatic technique during a bladder tumor operation. The feeding vessel is frequently difficult to see between individual muscle fibers. The technique is identical to that for prostatic resection. The vessel is coagulated with the cutting loop

larger tumors resected by the vertical approach it is advisable to take hemostatic measures at the base each time resection reaches the level of the bladder mucosa. The self evident truth that good visibility is the result of good hemostasis was mentioned in relation to prostatic adenomas but is no less applicable to bladder tumors.

It is almost impossible to coagulate arteries within the tissue of a papillary tumor since the entire growth tends to float away from the loop. Hemostasis is thus most safely and most simply secured in the mechanically resistant tissue of the tumor base. Spurting arteries are easily recognized there and coagulated by carefully aimed application of the loop. In practice, this means that removal of each piece of tumor is followed by hemostasis at its base. The rules that apply to the control of bleeding within the prostatic cavity are again to be applied (Fig. 208). Always search for the vessel with suitably adjusted irrigation, start by coagulating large vessels and progress to ever smaller ones with corresponding reduction in irrigation rate. Finally, coagulate small veins virtually without irrigation.

When resecting a bladder tumor it usually proves of value to use the energized cutting loop to 'hem' the entire margin of the resection area along the boundary between bladder mucosa and muscle (Fig. 209), just as a tailor places a selvage along the cut edge of his cloth. A fine white line will then be seen marking the boundary of bladder mucosa and resection field. It is along this margin that fine submucous venous plexuses may be found in the bladder. Since they are not individually visible they are best dealt with by this summary technique.

Difficulties may arise with the closure of arteries that lie deep between bladder muscle fibers. One of the rare cases in which I use a conical coagulating probe is when such vessels lie at the bottom of a narrow cleft, since they are then easily reached and subjected to spot coagulation.

Problems of venous bleeding analogous to those arising from prostatic ve-

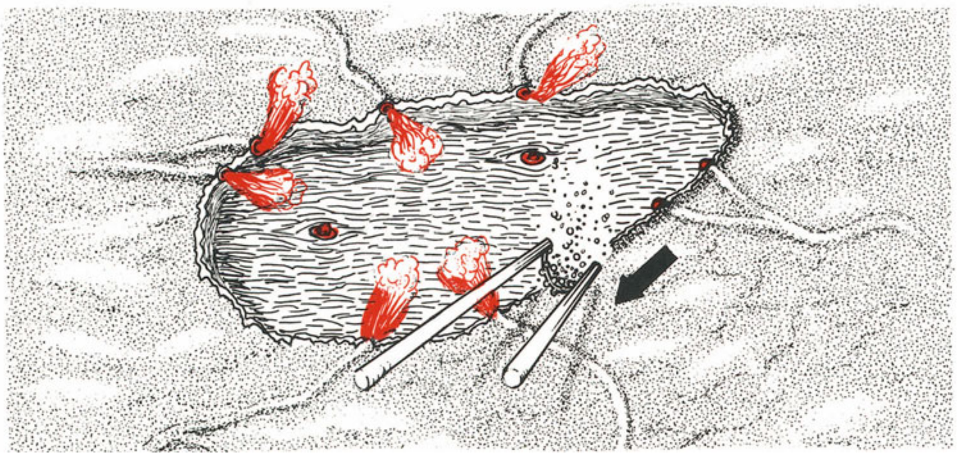

Fig. 209. Diagram of the 'hemming' technique of final hemostasis at the mucosal margin. This simplified diagram demonstrates the method of final hemostasis after resecting a bladder tumor. Numerous submucous vessels pour into the area of resection and are best closed by applying a weak coagulating current to the loop and then running this continuously around the cut margin of the mucosa so as to coagulate it. This phase of operation should be carried out under minimal irrigation so that even the smallest trickle of blood from the mucosa is easily recognized

nous sinuses do not occur during the resection of bladder tumors, unless the loop should accidently enter deeper layers of the muscle coat. Large perivesical veins may then be opened and prove extremely difficult to coagulate. It is difficult to maneuver the cutting loop within the deep cleft occasionally resulting from accidental muscle contraction, so that accurately placed hemostasis is hard to achieve. The only solution is to boldly yet carefully widen this incipient perforation so as to gain control of the vein in its depth. Apart from this rare problem, the resection of bladder tumors tends to present few difficulties of hemostasis, as long as the latter is undertaken immediately at the end of each stage of resection. This rule is of particular importance when dealing with extensive papillomatosis of the bladder. Before moving to a second region of the bladder, the first must be entirely dry of blood.

5. Special Types of Tumor Resection

a) Resecting Tumors on the Posterior Wall of the Bladder

Tumors on the posterior wall are difficult to reach for mechanical reasons. The loop is normally used to cut tissue as it is withdrawn into the sheath. In its standard form, it is, therefore, unsuitable for cutting by side-to-side excursions. If a loop is designed to project endwise out of the sheath it may used to execute 'mowing' movements from side to side as when a scythe or sickle is used to cut grass. Over 20 years ago, I used to create this type of loop by bending normal ones, since HEYNEMANN with whom I used to work on

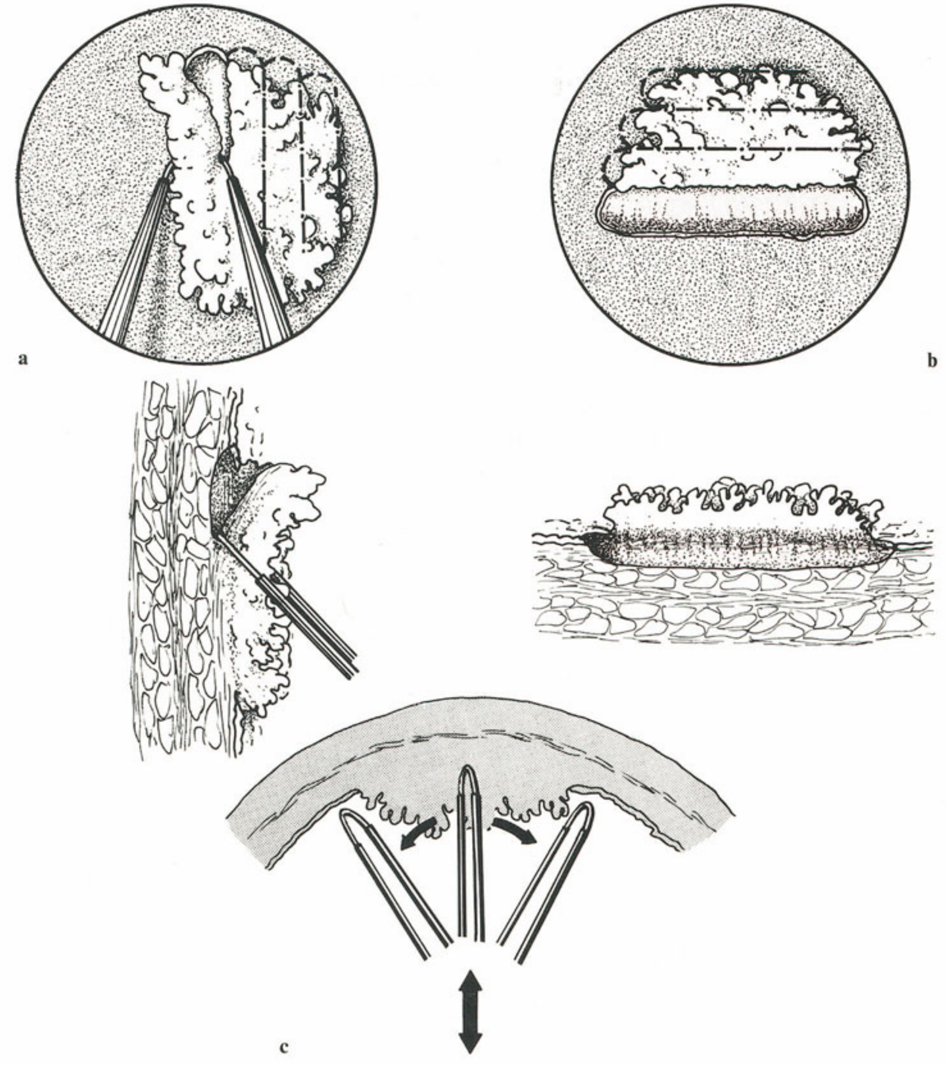

Fig. 210 a–c. Diagram of resection with the 'mowing' loop. In this technique the cutting loop projects freely from the end of the sheath. Cutting is no longer by advancing and retracting the loop but by a lever movement of the entire resectoscope. This renders it possible to take long slices across the posterior wall of the bladder. As shown in **a**, the direction of cut may also be from above downwards (ventral-dorsal) as well as from lateral to medial to lateral, as shown in **b. c** Shows the movements required for a horizontal cut. In order to match the curvature of the bladder a forward-and-back movement of the sheath must be added to lateral excursions of the loop

the design of instruments was always against such a construction. He felt it was far too dangerous, but in the meantime all the main German manufacturers offer such loops in their catalogues. I am not able to tell how frequently they are used since there are no appropriate publications. I myself first described such a loop in 1962 after many years of experience with it (MAUERMAYER 1962).

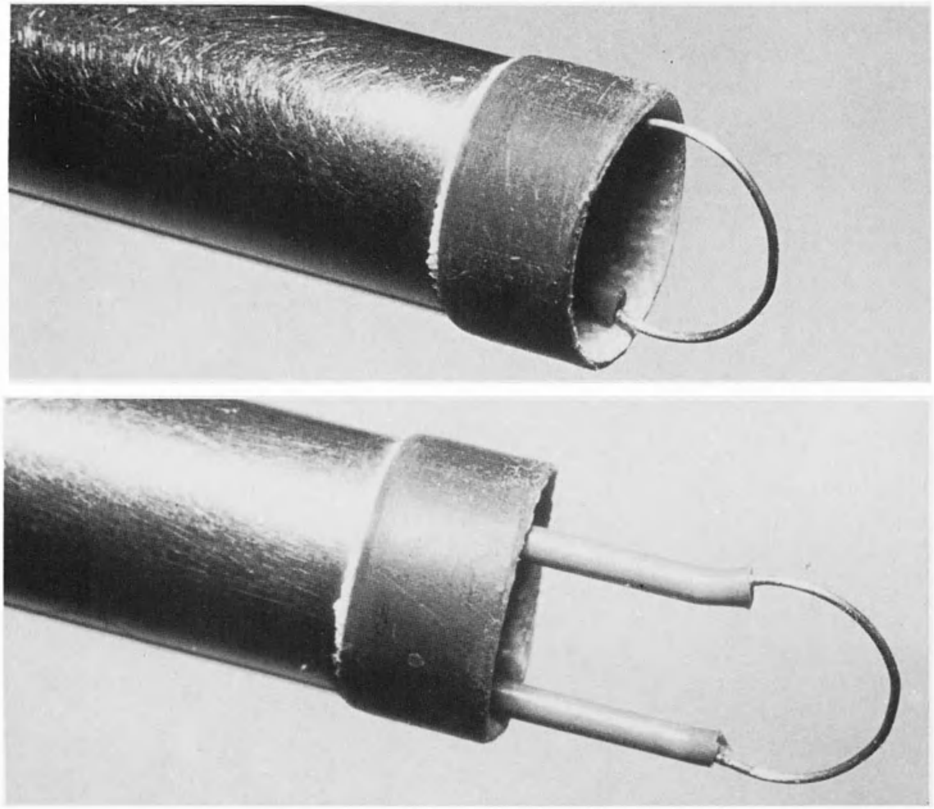

Fig. 211. The 'mowing' loop. The loop always projects somewhat from the end of the sheath, even when the electrotome is fully retracted. Great caution is therefore required when using this instrument! The fully extended loop is an extremely dangerous instrument in the hands of an inexperienced urologist. On the other hand, it so greatly facilitates work on the posterior wall that we would not be without it

A certain amount of practice is required to work with this instrument. Cutting movements are made with the loop extended and projecting freely beyond the end of the sheath (Figs. 210 and 211). A sheath with a long protective beak is unsuitable; an oblique one is needed. Cutting is achieved by simply passing the instrument medially across the center of the tumor toward the opposite side. 'Mowing' is the best description of this movement. Illustrations 73 and 74 (Plate XIII) demonstrate this technique in relation to a small tumor nodule.

This type of loop is not for beginners!

The technique of cutting is best practiced by passing the loop backward and forward across the tumor as described above without applying current.

It will then be seen that 'mowing' movements have more than one component, i.e., the path of the loop must match the curvature of the bladder. This requires the instrument to be advanced and retracted in the urethra during cutting. Beginners may find this difficult to carry out, however easy it is to visualize simultaneous 'mowing' and 'back and forth.' Coordination is only achieved by practice.

When training young urologists we start by allowing them to excise small papillary tumors requiring only lateral excursions of the loop. Nevertheless, working with this loop belongs to the last phase of their training. With adequate practice, the use of the mowing loop presents no problems, and we have yet to experience an inadvertent perforation.

This method reveals its full value in the resection of extensive tumor carpets and when exophytic tumors of the posterior wall project far into the bladder. Extensive cuts reaching well to either side considerably simplify and shorten the procedure.

Hemostasis must be undertaken immediately after opening any vessel, since the mowing loop so interferes with the irrigating flow as to impair visibility.

b) Resecting Tumors on the Lateral Wall of the Bladder

Unless the tumor has grown down into the immediate vicinity of the internal meatus this region of the bladder presents few difficulties purely in terms of operative technique (see Sect. c). The difficulties in this region arise because of the likelihood of initiating muscle contractions with their danger of inadvertent perforation (see p. 329).

Local anesthesia of the obturator nerve will avoid such spasms. It is, however, indispensable to check the success of this maneuver by transvesical faradic stimulation.

Only thus will the surgeon be protected from unpleasant surprises, the results of which might be all the more severe if blind faith in local anesthesia leads to all the normal precautions being abandoned (e.g., only slightly extending the loop from the sheath, firm grip on the instrument, small slices with minimum current, occasional use of a weak spark gap generator).

c) Resecting Tumors Close to the Internal Meatus in the Male

As noted earlier, the treatment of tumors in this region may occasionally require partial resection of the prostate. Since this widening of the bladder neck has the sole purpose of facilitating access to the tumor, it is limited to the absolute minimum, particularly in the case of young, still sexually active men in whom retrograde ejaculation should be prevented as far as possible (Fig. 212). In cases of infiltrating tumor, close to the meatus, it is nonetheless necessary to resect the prostate or bladder neck adenoma as far as possible so as to improve the radicality of the operation.

Prostatic resection may be required anywhere around the internal meatus, but particularly in the region of the lateral lobes and the vault (Fig. 213).

In occasional cases, and only with the patient's prior consent, we resect a transverse bar or the median lobe of a prostatic adenoma to facilitate instrumentation at the frequent follow-up cystoscopies that will be required. In older

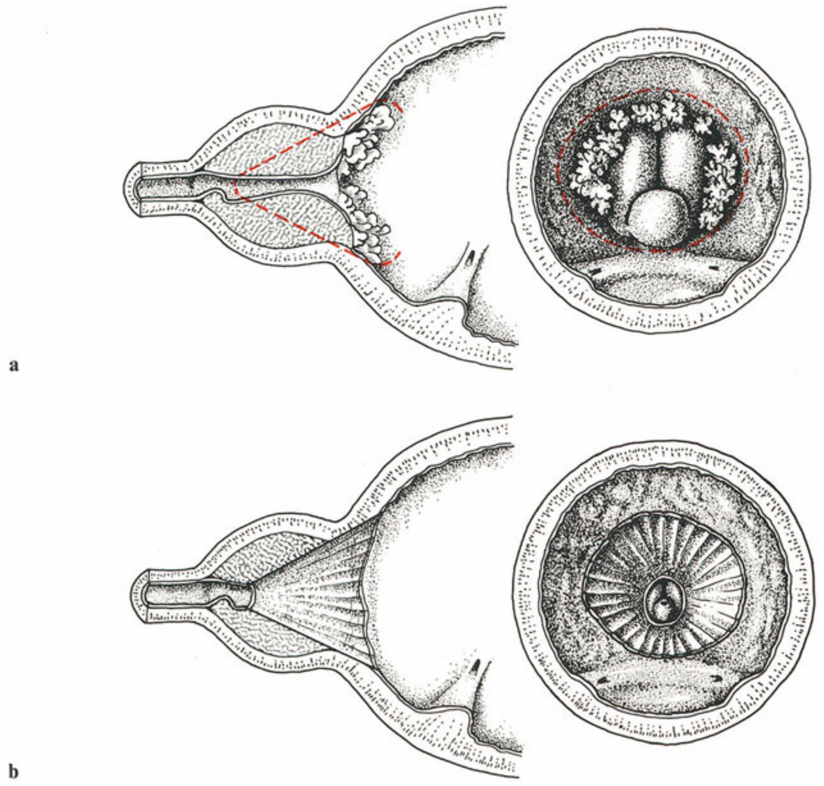

Fig. 212a, b. Diagram showing resection of a circular tumor around the internal meatus in a male. Tumors of this type can frequently only be removed with proper radicality after partial resection of the prostate. **a** Arrangement prior to surgery. **b** Arrangement at the end of surgery. Depending on the macroscopic suspicion of infiltration as seen through the resectoscope, the operation will have to proceed to a greater depth. A good safety layer is provided by removing the prostate down to the capsule. Once again individual tissue samples from various depths should be sent to the laboratory (perhaps from various segments) (see Fig. 215)

men with incipient adenoma formation we combine excision of the bladder tumor with generous resection of their prostatic adenoma in a single sitting, thus saving a second operation.

d) Resecting Tumors Close to the Internal Meatus in the Female

Tumors of this region should be excised as shallowly as possible, since deep resection in the vicinity of the sphincter may give rise to incontinence. In cases of papilloma or early papillary carcinoma this requirement is easily fulfilled, since the tumor may be cautiously ablated, completely sparing the sphincter. The problem becomes considerably more difficult in the presence of infiltrating carcinoma. The dangers of incontinence and of inadequate radicality will need to be carefully and accurately weighed against one another. This particular

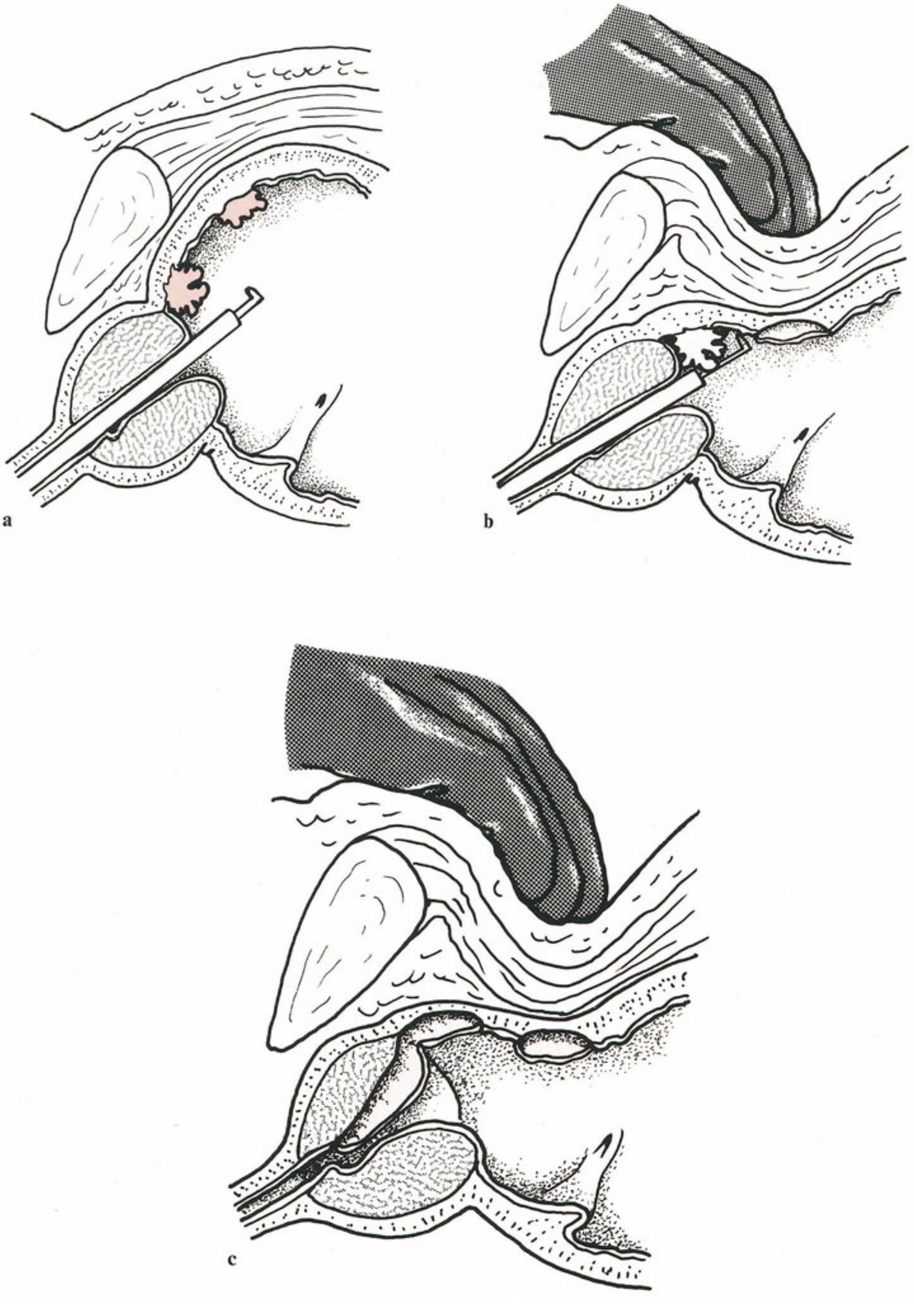

Fig. 213a–c. Resecting tumors on the bladder vault and around the internal meatus. a Initial arrangement prior to external counterpressure on the bladder vault. **b** The tumor close to the summit of the bladder has already been removed. The tumor around the internal meatus is rendered visible by counterpressure. Its complete removal requires ablation of part of the internal meatus. **c** Arrangement after complete removal of tumor

form of bladder cancer may restrict the indications for transurethral surgery and hasten cystectomy.

In our experience, vaginally palpable infiltration destroys any hope of a curative outcome to transurethral surgery.

e) Resecting Tumors on the Bladder Vault

In this region, resection is not fundamentally more difficult than elsewhere if one is used to single-handed control of the instrument. Rapid operative technique is helpful, since increasing distension of the bladder withdraws the vault out of range of the instrument.

The resectoscope should be held 180° inverted and controlled with one hand. The left hand presses the bladder down from above toward the instrument. The simultaneous control of irrigation is provided by pinching the inlet hose between thumb and index finger of the left hand. In this way, four fingers of the hand remain available to press the bladder down toward the instrument while varying pressure on the hose maintains control of irrigation (see Fig. 95).

The assistance of a nurse or auxillary may be valuable in obese patients where one's own strength is inadequate. On the other hand, it is more difficult to coordinate the actions of two people in such a subtle technique.

The gas bubble formating within the vault is often a considerable hindrance to surgery in this region. Under these conditions, a resectoscope sheath with central irrigating cock is invaluable (MAUERMAYER 1973; KAPLAN 1977), since the gas bubble may be evacuated under *direct vision* and the operation then immediately continued (Fig. 214) (see also p. 138).

The closer a tumor approaches the internal meatus, the more frequently concomitant resection of part of the prostate will be required in the male. Marked, head-down tilt of the patient and counterpressure on the bladder vault are extremely helpful (see Fig. 213).

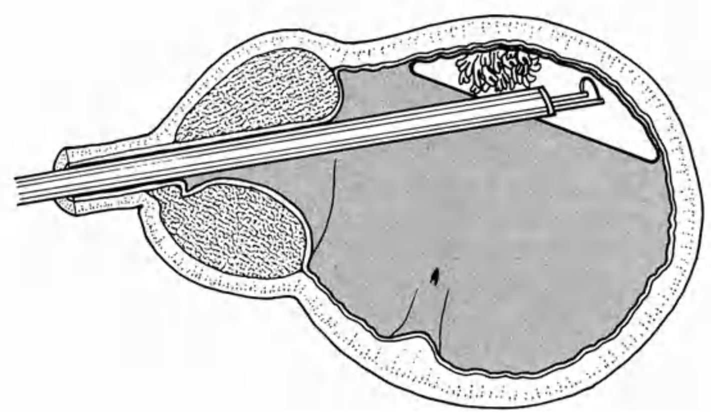

Fig. 214. Resecting tumors in the bladder vault. In such cases the gas bubble in the vault may cause difficulties. This is easily solved with a resectoscope with central stopcock, since gas may be evacuated under direct vision. After refilling the bladder with fresh irrigation the operation may proceed in the absence of gas

The manufacturers of endoscopic instruments have developed special angled resectoscopes and flexible coagulating probes for the treatment of tumors in this region. That would suggest that tumor surgery around this area presents special difficulties. For my part I wish to emphasize that *no* point within the male or female bladder is inaccessible to the standard resectoscope (which is perfectly suitable for careful resection of a tumor just as anywhere else in the bladder). The following techniques will provide a solution to any operative problem occurring in the vicinity:

1. Abdominal counterpressure on the bladder
2. Minimal filling of the bladder
3. Head-down position of the patient
4. Evacuation of the air bubble under direct vision

f) Resecting Tumors of or Around the Ureteric Orifice

An excretion urogram showing ureteric dilatation or nonfunction of a kidney will suggest even before cystoscopy that a ureter is invaded by tumor. Alternatively, a tumor adjacent to the ureter may be obstructing the urine flow. Tumors in this situation frequently appear as filling defects within the bladder shadow on IVU.

Noninfiltrating tumors around the ureteric orifice may be ablated without damage to the orifice itself. Careful shallow slices are the best technique and it is essential to first mark the position of the ureter either by passage of a ureteric catheter or injection of indigo carmine. Comparison with the healthy orifice on the opposite side may also be of help, since the bladder is usually symmetrical.

The generally held fear of the ureteric orifice is quite unjustified. When weighing the dangers it is obvious that tumor infiltration is of far greater significance than the possibility of subsequent stenosis or reflux. Either of these might later be corrected by further surgery. Controlled perforation is also entirely possible in the vicinity of the orifice. Carcinomas of this region should therefore be resected deep into the muscle as anywhere else. During such operations, the origin of the ureter within the muscle coat may be clearly seen, demarcated from the bladder wall musculature by Waldeyer's sheath. It frequently protrudes somewhat above the plane of section (see Illustration 75, Plate XIII). Once the muscle coat has been perforated, the ureter may be seen within the perivesical fat. Whether or not the ureter itself has been exposed can be tested by passage of a ureteric catheter.

In cases where the ureteric lumen itself is infiltrated by tumor (Illustration 76, Plate XIII), the ureter will again be seen lying within the bladder musculature. Tumor villi may be seen growing inside. Passage of a ureteric catheter will again prove that the transected structure truly is the ureter. This maneuver is easily accomplished through the resectoscope sheath by the insertion of a suitable operating unit in place of the electrotome. In the postoperative phase, this ureteric catheter will allow further diagnostic information to be gained by radiologic imaging of kidney and ureter.

The *complications* of such ureteric orifice resections may be either *cicatricial stenosis* or *reflux* (see Illustration 77, Plate XIII). Operative correction of stenosis is required whenever the free drainage of urine is obstructed with consequent ureteric dilatation. It should be dealt with as demanded by the further course of the illness, e.g., if a tumor with a tendency to recurrence is controlled by transurethral measures. Should the necessity of cystectomy arise, the problem solves itself during this second operation. In incurable cases undergoing palliative treatment, progress of the carcinoma and the condition of the opposite kidney will determine the course of events.

Reanastomosis of ureter and bladder should be achieved by some method obviating mucosal pouches such as inevitably occur in the BOARI flap technique.

Ureteric reflux is certainly not a harmless phenomenon (SCHMIDT et al. 1976; REES 1969). In our own practice, we have seen two cases of refluxing ureter with tumor spread to the upper tract, one of them associated with generalized metastasis. It is, of course, hard to prove whether such tumor behavior is due entirely to the implantation of seedlings or to multifocal change in the urothelium. HINMAN (1956) describes a case of metastatic implantation in the bladder neck during simultaneous prostatic and bladder tumor resections, and MARBERGER (1978) has described intraperitoneal seeding after perforation of the bladder. One must, therefore, conclude that tumor fragments such as are generated during any endovesical operation are capable of implantation. Our practice of instilling 1% silver nitrate is based on this concept. Due to the low overall probability of metastasis by this route it is hard to prove any beneficial effect. Other authorities recommend the use of cytotoxic substances such as thiotepa or mitomycin.

6. Tissue Recognition During Resection of Bladder Tumors

The appearance of the bladder muscle has already been described. In this section we shall concentrate mainly on recognizing tumor infiltration.

Bladder muscle is easily recognized endoscopically. Coarse muscle fibers are joined by scanty connective tissue. The fibers interlock markedly around the trigone forming a dense network of muscle.

It is quite easy to distinguish whether tumor infiltration belongs to a basically papillary or a basically solid carcinoma.

In purely tumorous regions, muscle tissue is completely replaced by tumor and nothing is seen except whitish, sometimes greasy, homogenous tissue. Bleeding is restricted to a few larger arteries.

As deeper layers are reached, muscle fibers appear initially sporadically and then in greater profusion but still embedded within the homogenous mass of carcinomatous substance. As one reaches a region *macroscopically* free of infiltration, the muscle regains its usual appearance of a loose arrangement of fibers without firm connection.

The situation is similar in papillary carcinomas, but the amorphous mass surrounding or replacing the muscle fibers is no longer homogenous but has a rather reddish color and is crumbly with a granular surface. Transection of such a mass not infrequently causes it to spill out between the muscle fibers as though it were under some pressure.

The transition from infiltrated to 'free' muscle is then somewhat more difficult to recognize. The telescope should, therefore, be closely approximated to the tissue in order to be quite certain of having reached an area free of infiltration.

The individual stages of tumor resection within the bladder wall are reproduced in Illustrations 68–72 (Plate XII). An explanation is provided by the detailed legend to each illustration.

7. Systematic Tissue Sampling as a Guide to Complete Resection

The above description is concerned with the macroscopic appearance of tissues. Such endoscopic observations during surgery remain nothing but supposition so long as carefully planned and placed tissue samples have not been made available for histologic analysis.

Tissue biopsies should, therefore, be taken according to a predetermined plan.

a) Single Sample with Directional Orientation

This method may be applied whenever one or more samples are removed from the depths of a resection zone to test whether the deepest point is clear of tumor. They thus are frequently taken from the apex of a crater dissected out of the bladder wall.

Individual fragments are removed by stopping the irrigation immediately after completing the cut and simultaneously removing the electrotome from the sheath. The bladder should first have been inspected to ensure there were no other floating fragments. Usually the tissue sample adheres to the loop and can be picked off. Care should be taken not to confuse luminal and adventitial aspects of the bladder. A pin is pushed into the fragment so that its point faces outward.

b) Sampling in Tissue Layers

This method consists of collecting samples from different tissue layers in the resection zone and then potting and despatching them individually (Figs. 215 and 216). This technique seems to be preferred in our clinic. When a papillary exophytic tumor is resected, the main tissue bulk down to mucosal level is first of all excised and potted. A subsequent sample comprises a deeper layer around the base of the tumor, and a third piece consists of the tumor margins together with adjacent mucosa and superficial muscle coat.

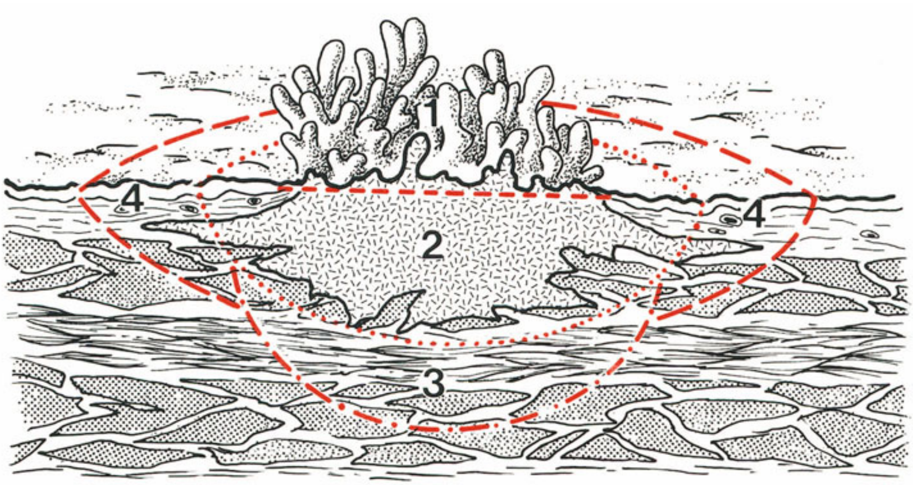

Fig. 215. Diagram of various biopsy zones. *1* Superficial parts of the tumor. *2* Progress of tumor resection to a region of macroscopically apparently normal musculature. *3* Excision of an additional layer, both for reasons of safety and for better appreciation of the tumor stage. *4* Peripheral resection in a circular fashion around the tumor base to detect possible submucous infiltration

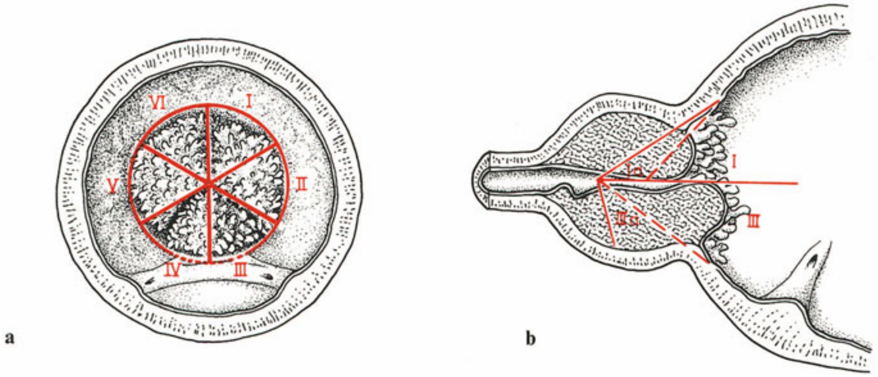

Fig. 216a, b. Diagram explaining the procedure for biopsying tumors around the bladder neck of the male. a Cross section through the bladder looking towards the bladder base and internal meatus. If the tumor lies all around the internal meatus it is helpful to send biopsy material from individual sectors separately (*I–VI*) so as to allow locally deeper resection (2nd layer) to increase radicality at an individual point. If deep penetration is proven, more radical open surgical procedures should be considered. **b** Same situation as **a** in sagittal section. If deep prostatic tissue is infiltrated, a second, more distally placed tissue cone should be biopsied for analysis. Only thus can one prove that resection has extended into healthy tissue. The cutting technique is the usual one for excavating the prostatic cavity

One will thus get quite a good idea of the degree of radicality achieved by the operation as well as detecting submucous tumor extension which is not infrequently present. If necessary, a directionally orientated biopsy may still be obtained from the depths of the resection crater as described under a) above.

It goes without saying that this technique can be applied separately for each one of multiple tumors whenever they exceed a certain size.

A different procedure should be adopted for tumors encircling the internal meatus. In such cases, it is advisable to arrange samples segmentally in a clockwise direction and to repeat this procedure as required in deeper layers. Only thus can any statement be made as to the completeness of resection down to uninfiltrated tissue. If any one segment still contains residual tumor within the deeper layers, a further locally deeper excision may be made.

It is advisable to document the site of origin of all such biopsy samples on a preprinted bladder diagram. BRESSEL et al. (1968) have made a detailed study of these problems.

The tissue fragments should be collected by directing the drainage hose into a collecting sieve which is emptied at the end of each individual sampling phase (see Fig. 102). It goes without saying that repeated endoscopic inspection is required to ensure the bladder is completely clear of fragments from previous biopsy sites.

This may all sound somewhat complicated but in practice such tissue sampling is simple. All the surgeon needs to do is to tap out the collecting sieve on a sterile cloth which he hands to an assistant, who will mark the source of the biopsy on the diagram and label it accordingly.

The surgeon himself will gain most from this procedure since he will be able to correlate the endoscopic appearances with the subsequent histologic finding and thus sharpen his eye for macroscopic tissue characteristics.

c) Biopsy Technique for the Diagnosis of Carcinoma in Situ and Other Early Urothelial Carcinomas

Rather than arising during endoscopy, the suspicion of such a diagnosis is likely to have come from preoperative urine cytology following the typical complaints of hematuria or dysuria. This section is not concerned with immunologic or epidemiologic problems associated with such precancerous change. We shall discuss only matters of operative technique.

Since the areas of change are nearly always small and it is, therefore, not necessary to biopsy large quantities of tissue, the use of forceps is nearly always adequate. On the other hand, mucosal samples should be provided from as many zones of the bladder as possible, and this will require adherence to a definite system. Only if close inspection of the mucosa with modern telescopes of high resolving power revealed suspicious areas such as erythema, or the characteristic depression of 'nests of Brun' should additional biopsies be taken. The reason for the low probability of primary localized endoscopic diagnosis probably lies in the fact that these areas of atypia arise in the basal cell layers (TANNENBAUM and ROMAS 1978). Probable sites of election are the trigonal region and the posterior wall of the bladder, particularly in its medial parts (ZINCKE 1978). Biopsy should be taken with a forceps designed to cause minimum tissue damage, best of all with an instrument of the Lüer gouge forceps pattern. Only the edge of the jaws is involved in cutting, so the tissue sample lies freely within, without being subject to pressure and is of adequate size for histologic examination. Minor hemorrhages from the mucosal margin should be immediately coagulated, since they will otherwise so impair visibility as to render continued topographic orientation impossible. Because a large number of biopsies is always required, general anesthesia is advisable.

8. Controlled Perforation

a) Preliminary Considerations

I owe my knowledge of this technique to a demonstration by FLOCKS, although in the early years we nonetheless had to fell our way toward the limits of the possible. We are thus all to some extent self-taught.

The anatomical basis for this procedure is the subdivision of the bladder into two zones, the 'free' and 'fixed' (see Fig. 194). In the free zone of the bladder the presence of the peritoneum, the Cave of Retzius and the looseness with which fatty tissue surrounds superolateral parts of the bladder prevent the use of this technique. The result would be free perforation requiring immediate surgical treatment.

The fixed zone of the bladder, however, is surrounded by fat closely adherent to the bladder wall.

A second factor facilitating this procedure for infiltrating tumors is the fact of perivesical infiltration of the fat around the tumor. This is *not* a carcinomatous change, it is inflammatory. The fatty tissue is tougher, rather more edematous and of homogenous consistency.

Finally, this procedure is made possible by the fact that the site of bladder tumor resection develops a perivesical leucocyte infiltration after only a few days, even if the bladder was not perforated. This results in the fat becoming firm and solid. It adheres to the bladder wall and prevents irrigating fluid required for resection from escaping from the bladder via any controlled perforation.

There are three prequisites for this maneuver. First of all the tumor must be ablated and traced down as deeply as possible into the muscle coat. If one is uncertain whether the deepest layers of the wound cavity are macroscopically free of tumor, a separate sample may be taken from the base of the crater and sent for histologic analysis. In the few days that elapse until the report is available, perivesical infiltration will occur enabling deeper penetration without mishap. If the biopsy shows residual tumor tissue, surgery must proceed to a greater depth. We call this "resection of the second layer." Anybody practiced in this technique may, however, proceed out into the fatty tissue at the first sitting without such a pause.

b) The Technique of Controlled Perforation

This special operative procedure commences when the tumor has been ablated down to the level of bladder mucosa. First of all a further tissue layer is resected.

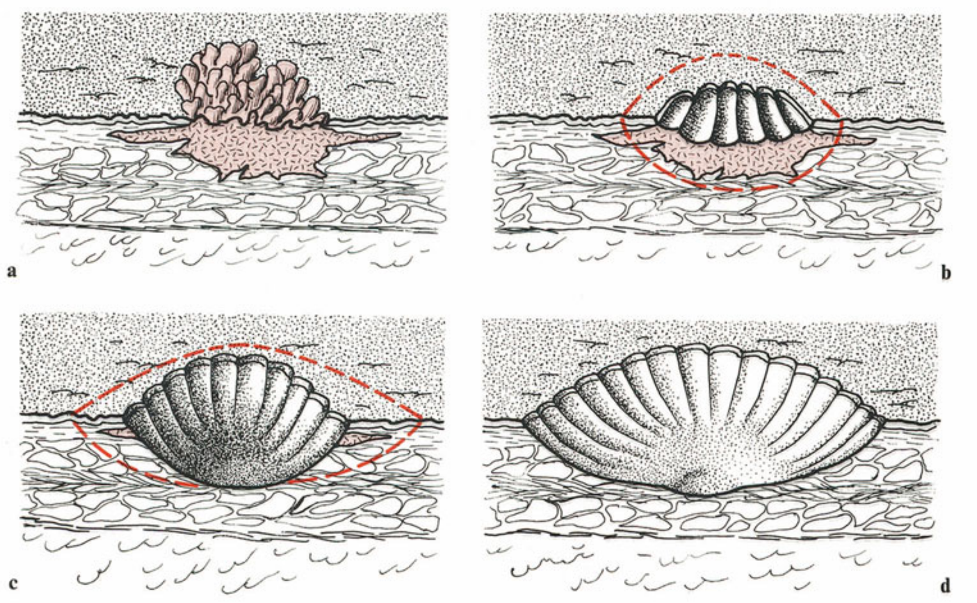

Fig. 217a–d. Diagram showing resection of a T_{1-2} tumor. a Initial situation. **b** Arrangement after ablation of the exophytic part. **c** Excavating the bladder wall until a deeper, tumor-free zone is reached. **d** Resection of a marginal layer

Even at this early phase of the operation, scrupulous control of bleeding is indispensable. The irrigating fluid should never be allowed to take on more than the merest blush. When removing a carcinoma there is absolutely nothing to be lost by coagulating wide zones around each vessel so as to staunch even the slightest parenchymatous bleed. The same process should be used to remove a second layer, thinner than the first on grounds of caution. Since only the appearance of the tissue can now decide whether progress is required to greater depths, it should be closely examined at maximum magnification by bringing the telescope right up to the cut surface. It is usual for perivesical fat tissue to appear in the center of the crater, heralded initially by thinning out of the muscle layer (Fig. 217). Once again, as in all phases of this operation, the importance of scrupulous and immediate hemostasis cannot be adequately emphasized. For an illustration of the technique see Illustrations 68, 69, 71, 72, Plate XII.

c) Irrigation During Controlled Perforation

The *influx* of irrigating fluid should be reduced to the minimum possible. Because of the high quality of hemostasis, the irrigation needs only to clear the field of fine floating particles. Even the minutest bleed will be immediately staunched before operation proceeds. Thus the bladder will only slowly fill, and strict adherence to this procedure will keep intravesical pressure so low that irrigating fluid would be unlikely to escape even if the fat were not adherent.

The three pillars of this technique are then in summary:

1. Careful dissection guided by tissue appearance
2. Immediate hemostasis after every cut
3. Slow and restricted filling of the bladder

As long as these three rules are observed controlled perforation is an excellent technique for the excision of tumor pegs penetrating deeply into the bladder wall. It is a matter of necessity that this technique can only be justified when guided by histologic analysis. This was emphasized at several points in the chapter. Any evidence of deep or even perivesical infiltration with tumor should lead to an alteration of therapeutic strategy.

9. Resecting the Periphery of a Tumor

During our discussion of the modes of spread of carcinoma of the bladder, it was pointed out that tumors not only infiltrate downwards through the muscle but also in a peripheral direction. Resection technique must take account of this behavior.

There are two types of peripheral spread: submucous, visible is endoscopically as a tough margin surrounding the base of the tumor, and intramural, both as endolymphatic and as tentacular extension.

Just as open surgical partial cystectomy would not aim to excise the tumor immediately around its base but must also excise a safety margin, endoscopic surgery must remove a margin of muscle extending beyond visible tumor and provable infiltration. Limits to this procedure will naturally arise in extensive carcinomas.

In this regard histologic guidance is once again the only measure of radicality.

10. Palliative Resection

As stated at the outset, electroresection of bladder tumors may be indicated either with a view to cure or for the simple palliation of certain symptoms, such as hematuria, dysuria and frequency or urgency. The aim of operation then becomes the most extensive possible removal of all accessible tumor tissue (MARBERGER 1978).

Technique of palliative resection. In most cases there will be large necrotic tumor masses. Once again, resection should start on the surface of the tumor by removal of the irregular necrotic portions until a smooth, clean surface is achieved. Further resection is then identical to curative procedures. In most such cases the operation is technically easy and layer after layer should be removed in whatever direction seems most accessible. Whenever one of the rather infrequent arteries is transected there will be vigorous hemorrhage. The extended cutting technique, i.e., cutting by simultaneous movements of loop and sheath is often of value. Resection chips may be just as difficult to evacuate as in cases of prostatic carcinoma, since they tend to be rigid and get stuck within the sheath.

The bladder base may be deeply dissected without fear of mishap so long as a previous rectal (vaginal) examination has demonstrated deep infiltration.

Around the periphery of the tumor as much tissue should be removed as possible. At the end of the procedure there will be a large deep wound cavity. If there is tumor around the internal meatus as much prostatic tissue should be removed as possible.

The procedure is the same whether it is for the treatment of hematuria, dysuria or reduced bladder capacity due to the presence of tumor.

Postoperative treatment is just as for any other tumor resection. These tumor masses are frequently infected and antibiotic treatment is recommended. It is not usually possible to completely eliminate infection, yet it may be brought under control and the symptoms thus reduced.

It may be necessary to repeat palliative treatment several times whenever the patient's condition demands it.

VI. Accidents During Resection of Bladder Tumors

1. Preliminary Considerations

The most important, and indeed almost the only operative complication arising during bladder tumor resection is perforation. Such unintentional free perforation is something fundamentally different from the intentional controlled variety. It occurs whenever resection is carried deeply into a region of the bladder wall unsuitable for deep dissection in an attempt to achieve maximum radicality. Such a 'transurethral laparoscopy' is an extremely impressive if somewhat terrifying experience. Luckily it is rare, occurring among our patients with an overall frequency of approximately 1:1000, in some years more frequently, but never more than 1:700, despite the fact that we are a teaching unit. Any transurethral surgeon must be equiped to deal with this event however rarely it may occur. The appropriate provision to be made in the operating room has already been discussed in the appropriate sections.

Free perforation immediately recognized and appropriately treated barely influences the patient's hospital stay or his recovery.

2. Types of Perforation

a) Intraperitoneal Perforation

This accident will occur whenever the surgeon attempts to excise a tumor too deeply from the posterior wall of the bladder. The tumors are generally actively infiltrating, and the surgeon tries to reach the full depth of infiltration. Actual perforation cannot be mistaken: the tissues suddenly give way, there is loss of resistance to the instrument and it slips through into the peritoneal cavity, where loops of intestine are visible.

The diagnosis is thus made and the operation must be immediately interrupted.

The senior nurse in the operating room should be informed and the anesthetist alerted. A surgical assistant must immediately make himself available.

Since we have an operating lamp fitted above every table and a suitable instrument set is always ready, the only delay consists of the time taken to paint the abdomen and for the assistant to scrub up. Once the suprapubic operating field has been draped, the peritoneum should immediately be opened. Early recognition of the complication greatly reduces the entry of irrigating fluid into the abdomen. The site of perforation is found, the intestines packed away and the hole in the bladder closed in two layers. First of all the muscle coat is closed in a through and through fashion, and this stitch line is then buried under the peritoneum, which has been somewhat mobilized from the bladder. Both sutures are of chromic catgut, continuous on the peritoneum. If, as usual, the perforation is a small one, no suprapubic bladder drainage is necessary. Larger or more inferiorly placed perforations may be more difficult to close and demand suprapubic bladder drainage by a 16-Ch balloon catheter. The peritoneal cavity is washed out with antibacterial solution and the wound closed in the usual fashion, with a drain. As a result of such rapid intervention intraperitoneal perforation is a minor event for the patient. Postoperative treatment demands the use of prophylactic antibiotics. The catheter is removed in the usual fashion after approximately one week.

b) Extraperitoneal Perforation

Extraperitoneal perforation not infrequently results from sudden muscle contraction in the distribution of the obturator nerve. Local anesthetic block of this nerve is an excellent means of preventing such sudden movements, and the techniques involved were described at the beginning of this chapter.

It is not quite so easy with this type of perforation to decide whether immediate surgery to close the hole is indicated, but it will in any case be less urgent. We assess the indications for surgical treatment in terms of two observations:

1. Appearance of the perforation
2. Contrast radiology of the bladder

The perforation site should first of all be carefully inspected according to the same basic principles as already described for various types of prostatic perforation. In just the same way one may distinguish widely open, free perforations of the bladder from perforations covered by firmly adherent fatty tissue. In a case of free, uncovered perforation the free efflux of irrigating fluid through the opening and its partial return on draining the bladder may be easily seen. Under these circumstances contrast cystography should immediately be undertaken and any further procedure made dependent on its outcome. A large pool of contrast outside the bladder will suggest a wide opening requiring surgical exposure, closure of the hole and drainage of the area. On the other hand, modest extravasation associated with an endoscopically small hole may be treated conservatively by antibiotic cover and prolonged indwelling catheterization. At a second sitting after the wound has healed it will have to be decided whether a further resection should be attempted to completely remove the tumor.

c) Gas Detonation

During any electroresection oxyhydrogen gas is formed by thermal decomposition (FLACHENECKER 1978). Under some circumstances this gas may be detonated with consequent perforation of the bladder. We have occasionally seen such explosions, always *without* perforation and have subsequently modified our technique accordingly.

Detonation only occurs if a spark generated during cutting passes through the gas mixture and ignites it. Since gas rises upwards, ventrally if the patient is in the normal position on the operating table, it will accumulate in the bladder vault and is thus only a hazard during operations in that region.

If a tumor is being resected in this vicinity care should be taken to evacuate gas from the vault every time the bladder is emptied. This may be easily checked by an initial inspection of the area with minimal irrigation. Evacuation of bladder vault gas is rendered particularly simple by the use of a sheath with a central irrigating cock, permitting evacuation under direct vision.

Theoretically transurethral operations of modest extent could equally be undertaken in an air-filled bladder. On the rare occasions one attempts this it immediately becomes apparent that a very much lower intensity of cutting current is required, since there is no longer any high-frequency diversion through the irrigating fluid (the latter is not entirely free of electrolyte because of blood contamination). If one does operate within such a gas bubble in the bladder vault, the cutting loop frequently smoulders away after only a few slices. For this reason the gas bubble in the vault should be evacuated every time the bladder is emptied.

VII. Check Cystoscopy Following Transurethral Resection of Bladder Tumors

The intervals between check cystoscopies should be adapted to the malignancy of the tumor, its potential for recurrence and one's expectation of the operative result. Cases of palliative resection will remain under supervision because of their symptoms. Cystoscopy will be repeated as dictated by the clinical picture, e.g., increasing complaint of dysuria, further hematuria or other symptoms arising from the tumor.

For patients undergoing surgery in the hope and expectation of cure the histologic grade of the tumor is the most important factor governing the frequency of cystoscopy. Papillomas or highly differentiated papillary carcinomas with proven infiltration should first be re-examined approximately 3 months after surgery. All cases of carcinoma, particularly if there is superficial muscle infiltration should be reviewed after no more than 6 weeks. Unexpected symptoms such as hematuria or renewed dysuria are an indication for earlier cystoscopy.

Since the bladder neck of male patients will already have been prepared for repeat examination by the removal of possible obstacles to cystoscopy (transverse bar, median lobe, adenoma) these check examinations are usually unproblematic. They are undertaken on an outpatient basis under urethral anesthesia.

If no recurrence is found at the first review and the operative wound is well healed, 3 months may elapse before the next cystoscopy. Occasionally a further growth is found at the first check and subsequently removed. Freedom of recurrence may then ensue from this second procedure. Such findings may be interpreted to mean that the first operation left a small island of carcinomatous tissue within the bladder wall detectable only at subsequent cystoscopy because of its additional growth.

In the course of repeat check cystoscopies and supplementary resections we not infrequently notice a decrease in grade of malignancy in some patients and an increase in others. The intervals between cystoscopies should vary according to these observations. Whatever else, a patient who had a papilloma or G_I tumor and remained free of recurrence after the first operation should nevertheless be cystoscoped yearly. It is a recurring experience that for reasons unknown new growths may arise even after several years without tumor recurrence.

Two things should be emphasized to the bladder tumor patient:

1. Regular check cystoscopies are a safety procedure which should not arbitrarily be abandoned
2. Cystoscopy may be unpleasant but should never be painful and under no circumstances should infection result

The surgeon should attempt to establish a special human relationship with his bladder tumor patients, in which they can find a sense of safety and security by undergoing regular re-examinations.

VIII. Concluding Remarks on Bladder Tumor Resection

Transurethral therapy is ideal for the treatment of certain types of bladder tumor once the surgical technique has been mastered. It is certainly not the ideal solution to every problem. Anyone who has experienced the changing face of medicine will well know that certain methods remain on the fringe for a while, then become 'fashionable' and finally lapse into oblivion. The description of bladder tumor resection given in this chapter is the outcome of my personal experience as a urologist over the last 30 years. Indeed, it may be something more, something of a declaration of faith in the transurethral method of treatment, the results of which will only be excellent so long as certain technical requirements are satisfied. I would ask anyone who finds my suggestions too didactic to consider that there may be many seeking exact instructions, having not had the good fortune to train in a high-class teaching unit.

IX. Other Transurethral Bladder Operations

Litholapaxy is discussed in Chap. I under individual headings of mechanical, shock wave and ultrasound litholapaxy. The Zeiss loop is considered in detail in Chap. K. There thus remain only a few minor bladder procedures to be considered, all of them having the use of cutting current or a resectoscope in common with electroresection. In this sense transurethral treatment of bladder diverticula may usefully complement suprapubic operation. Incision of the ureteric orifice has rightly been abandoned because of the high incidence of associated reflux. This procedure is therefore no longer described.

1. Incising the Neck of Bladder Diverticula

a) Preliminary Considerations and Indications

Diverticulum is a not infrequent complication in patients with bladder outflow abnormalities. Transurethral treatment may be a simple supplementary procedure during resection of the prostate. Particularly in cases where an extremely narrow diverticular orifice impedes emptying of the diverticulum, incision of the neck may so improve drainage as to obviate formal excision (Fig. 218). Where the diverticulum is of greater capacity than the bladder, fluoroscopy frequently reveals how the patient urinates into his own diverticulum. The result is a considerable residual volume within the diverticulum despite complete emptying of the bladder proper. Such cases, characterized by an extremely thin-walled diverticulum, are best treated by excision. All others in whom micturition in front of the image intensifier reveals good contractility of bladder and diverticula alike, with equal distribution of residual urine between the two, are suitable for transurethral therapy.

b) Operative Technique

The procedure is basically simple. The resectoscope sheath is passed into the diverticulum and an increasingly deep groove is cautiously cut at one point

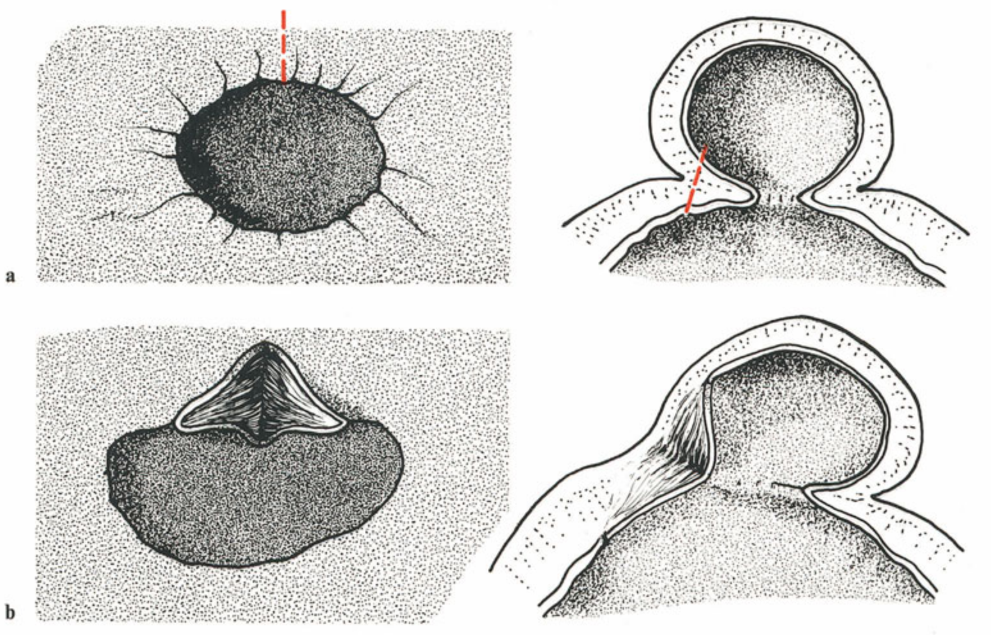

Fig. 218a, b. Incising the neck of a bladder diverticulum. *Left:* Diagram of the endoscopic view. *Right:* Diagrammatic section. **a** Site of incision. If the neck is very narrow, several incisions may be made at various points. The opening then gapes more widely. The line of incision is indicated in the section. **b** Arrangement at the end of incision. Note in the section that the cut does not completely penetrate the muscle coat, leaving deeper layers intact

through the diverticular neck. The sole problem of operation is early recognition of the moment at which the bladder wall is penetrated and perforation becomes imminent. The experienced surgeon will soon recognize this point by the attenuation of the muscle coat and the presence of copious connective tissue. Although in bygone days this procedure was frequently undertaken with a wire probe in the operating cystoscope, we nowadays prefer to use a resectoscope.

This has the advantage that the same techniques may be used as applied to prostatic and bladder tumor resections. The incision can thus be broadened and increased in depth or repeated in several places as required. As a result the opening may be made so large that the diverticulum simply becomes a zone of the bladder. Hemostasis is also considerably simpler with the resectoscope than with any other instrument.

Where two diverticula share a common wall the latter may be excised, making one diverticulum out of two and finally so widening the mouth of both diverticula as to make them part of the bladder in general.

This operation is occasionally required for diagnostic purposes, particularly if a narrow-mouthed diverticulum requires cystoscopic inspection to exclude the presence of a bladder tumor (diverticular tumor).

The procedure is concluded by scrupulous hemostasis. Subsequent cystogram provides for follow-up of the operative result.

2. Injecting Drugs into the Bladder

The chief indication for this procedure is simple ulcer, in which considerable improvement may be achieved by the direct injection of hydrocortisone acetate into the ulcer. Although no method is capable of achieving complete healing, this is a relatively simple technique usually suitable for outpatient use without anesthesia, which may give considerable symptomatic relief for several months.

The technique is simple. An operating cystoscope with a wide instrument channel and a flexible injection needle is directed towards the ulcer. The syringe is operated by an assistant, 0.1 ml being applied to each injection site. Patients whose ulcer has a marked tendency to spontaneous hemorrhage require a rapid operative technique, since increase in bleeding will soon so impair vision that the operation cannot be continued.

The injected solution consists of 25 mg hydrocortisone acetate in 1 ml, drawn up in a tuberculin syringe allowing the precise injection of 0.1 ml at a time. If such a syringe is not available the solution may be diluted in 4 ml physiological saline, thus once again permitting precise dosage.

The injection points should be uniformly distributed around the ulcer. Large ulcers will require correspondingly more injection points, one per square centimeter.

Chapter H

Special Resection Procedures Around the Bladder Neck

I. Introduction

So far we have discussed resection of small, moderately large and outsize adenomas. In addition to this there are a large number of individual clinical problems requiring a degree of variation and adaptation in resection technique. The basic rules of cutting and hemostasis remain the same, yet a number of individual technical features are worthy of special mention. They appear in the following in the order of relative frequency.

II. Electroresection of Prostatic Carcinoma

1. Preliminary Considerations and Indications

The sole aim of electroresection in prostatic carcinoma is the re-establishment of free urine drainage for the longest possible period of time. A number of authors (ARNHOLDT 1973; REUTER 1980) have suggested 'radical' electroresection as a *cure* for carcinoma, by analogy to radical perineal or retropubic surgery. The small numbers of cases they report are not, however, likely to invalidate the arguments against such procedures. Lack of radicality is certainly the chief one, since neither seminal vesicals nor lymph nodes can be resected transurethrally. Furthermore, the procedure is difficult even for the most experienced surgeon. The only possible successes of this method are likely to be in the rather isolated cases that are really FLOCKS (1943) stage A, and these are surely the ones most deserving truly radical treatment.

Transurethral surgery, on the other hand, may emerge as a blessing for the patient if it is employed to re-establish free drainage of urine. Equally, dysuric symptoms due to tumor necrosis and recurrent hemorrhage may be an indication for surgery. The occasionally insufferable symptoms of infected and necrotic tumors may be markedly improved by bladder neck 'toilet.'

Surgery should only be undertaken if the patient's life expectancy is such that he will be able to enjoy its fruits in the form of a period of normal or only mildly abnormal micturition, and if his general condition permits. Unless these prerequisites are satisfied the question of suprapubic cystostomy or indwelling catheterization should be discussed with the patient. In my experience patients prefer cystostomy.

2. Operative Technique

This operation does not differ fundamentally from the technique for adenomectomy, apart from the following special points:

a) Commencing the Operation

In many cases the prostatic urethra has been so constricted by carcinoma as to severely impede movements of the instrument. A funnel-shaped area of tumor must first be removed to allow free drainage of irrigating fluid into the bladder and evacuation of resection material. Only thus will the instrument gain freedom of movement. Initially it may appear that no further tissue can be removed, yet the more one proceeds with the operation the easier it becomes to dissect juxtacapsular tissues.

b) Hemorrhage

There is frequently less bleeding than usual, but one should not depend on this as a rule. Especially during attempts to remove the carcinoma as far down to the capsule as possible, one may come across numerous arteries, some of them of considerable caliber. Venous sinuses are extremely rare.

c) Evacuation of Chips

Resection chips are often tough, just like their tissue of origin. They may be difficult to extract, particularly if one has cut them large and long.

d) Resection of the Prostatic Apex

Particular care should be taken in cases where definite identification of the verumontanum is rendered difficult by endourethral infiltration (often pseudopapillary). If the verumontanum cannot definitely be demonstrated, even with rectal support, residual tissue must be left in the appropriate area as a safeguard against injury to the external sphincter. This is all the more advisable whenever rectal palpation suggests tumor growth distally into the external sphincter region. For these cases we rely on the sphincter test of TAMMEN as well as the hydraulic technique of HARTUNG (see p. 116, 117), using a faradic current in the resectoscope loop to stimulate muscle contraction or rhythmically compressing and releasing the irrigating tube.

Repeated resection is more likely to benefit the patient than a single daring operation ending in urinary incontinence.

Such second-look operations allow one gradually to approach the limits of the possible and are usually so brief as to represent a minimal insult, even to patients who are poor operative risks.

In fact, such cases are rare. The seasoned surgeon will in many cases, recognize the remains of the verumontanum where an inexperienced surgeon sees only an irregular urethral floor.

e) How Much to Resect?

There is considerable difference of opinion as to how much tissue should be removed. Some advocate resecting only the amount required to guarantee adequate micturition (CIFUENTE DELATTE 1969; BLANDY 1971), while others suggest the most extensive possible excavation of the cavity (DENIS 1959). A number of authors remain silent on the subject. To enable patients with prostatic carcinoma to urinate, it is probably adequate to simply cut a channel through tumor tissue around the bladder neck. This channel through the rigid unresilient tissue might provide for good micturition for some time, but the frequently rapid growth tendency of some carcinomas would require frequent repetition of the procedure. It is therefore preferable always to clear the bladder neck as far as technically possible. It is quite frequently surprising how much tissue can be removed even when rigid tumor hardly allows any movement of the instrument at the outset. Capsular tissue is frequently involved in tumor and may not be endoscopically recognizable, but that is of little significance as long as one continues resecting all recognizable tumor tissue accessible to the resectoscope loop.

The rationale for thus excavating the cavity even in carcinoma cases must lie in an attempt to save the patient numerous subsequent resections, or at least to reduce their number.

Such an assessment of the indications is naturally tied to a corresponding life expectancy and a good general condition. The concept of such extensive resection of carcinomas should not be confused with an attempt at radical transurethral surgery for carcinoma of the prostate.

Palliative resection should be employed whenever the patient's general condition is so poor that he will only tolerate a minor procedure in the attempt to spare him indwelling catheterization.

f) Resection for Recurrent Hemorrhage

Recurrent hemorrhage nearly always arises from fairly advanced carcinomas. Attempts at controlling bleeding by coagulation of visible vessels are only likely to be successful in the case of an individual and clearly visible artery.

The procedure is indicated whenever hemorrhage is so profuse as to give rise to clots or when its duration or frequent recurrence is the cause of severe anemia. Occasional minor hemorrhage should not be regarded as an indication.

The problem is usually one of multiple parenchymatous oozing incapable of spontaneous arrest in the crumbling necrotic tissue.

Only resection of all accessible tissue will help, and this should be continued until mechanically more solid and better nourished tissue levels are reached. Hemostasis will present no problems at this depth.

g) Resection of Necrotic, Infected Tumors

Just as for carcinomas of the bladder, removal of decaying, necrotic tumor moities may provide considerable transient relief of severe dysuric symptoms related to some forms of carcinoma of the prostate. The maximum possible quantity of tissue should be resected compatible with avoiding incontinence.

h) Resecting Tumor Infiltrating the Bladder

Infiltration of the bladder may be so dominant in some carcinomas as to prevent clinical differentiation from bladder tumors of the internal meatus. In any case, extensive resection will be required and should include all endovesical extensions. These tumors are frequently poorly differentiated carcinomas difficult to classify histologically with any certainty. Tissue phosphatase levels should therefore be estimated in order to determine the origin of the tumor, since definite prostatic carcinoma will always be suitable for a trial of endocrine therapy. We have on several occasions attempted resection of ureteric orifice infiltration, but always without lasting success.

III. Resection for Bladder Neck Fibrosis

The literature abounds in a variety of names for this condition. 'Median bar,' 'bladder neck fibrosis,' 'prostatisme sans prostate,' and 'Marion's disease' are all applied to more or less the same clinical picture. The dominant feature is marked bladder outlet obstruction with normal rectal findings, often affecting young people, but occasionally found in elderly men.

Because of its slow initial progress this disease frequently remains unnoticed for a considerable time and this may result in bladder atony. Resection should therefore be particularly thorough, since only thus may the disturbed equilibrium between detrusor and bladder outflow resistence be restored. For this reason a number of important details must be mentioned in relation to operative technique.

The bladder neck is usually no longer than normal. The only endoscopic abnormality is occasionally a marked upward protrusion of the internal sphincter ring. The term 'median bar' generally used in the Anglo-Saxon literature is most appropriate for this situation. Sometimes the internal meatus may be constricted. The transverse bar is of a tough consistency and cuts as a rigid fibrous ring.

It is never adequate to merely excise a groove from this ring; a properly planned resection should be carefully executed. Tissue of the fibrous ring should be serially removed until softer layers are reached. This procedure should encompass the entire circumference of the internal meatus, rather than being limited to the dorsal area.

Prostatic glandular tissue never occurs around the internal meatus. It is limited to the region of the verumontanum but needs to be removed with the same care lavished on adenomectomy. There are two reasons for this:

1. Glands partially devascularized during initial surgery may subsequently become infected. Because of the poor blood supply such infections are virtually untreatable.
2. Numerous cases of bladder neck fibrosis result from chronic infection. It is therefore mandatory to remove already infected glandular tissue.

The only technical difficulty in this part of the procedure arises from the restricted space. Slices should be shallow and short. I frequently find that steadying the little finger of my left hand against the patient's thigh improves my accuracy. Rectal support is often of value.

Strangely enough one nearly always removes 6–8 g of tissue from such cases, although it seems at the outset that just a few cuts will suffice to clear the prostatic cavity of all tissue.

Special care is required during resection of the paracollicular regions. A particularly wide and smooth transition from prostatic cavity to membranous urethra should be created. Whenever I am uncertain whether I have really removed enough tissue, I carry out trial micturition by first filling the bladder to capacity and then expressing irrigating fluid by suprapubic pressure. Unless the urinary stream is satisfactorily forceful the instrument is reintroduced and a careful search carried out for residual removable tissue. The sphincter tests of TAMMEN and HARTUNG are invaluable in this situation in indicating with absolute certainty the limits of possible resection. Only when trial micturition results in a massive stream is final hemostasis carried out and the instrument removed.

IV. Resection for Outflow Obstruction in the Female Bladder

1. Preliminary Considerations

The clinical picture of female bladder outflow obstruction has been recognized for some time. NELSON et al. (1957) quoted AMBROSE PARE, who described bladder neck stenosis of women in 1575, as well as DE GROOF (1672). Despite their medical historical interest, these initial clinical reports have left no lasting impression in medical literature.

CAULK (1921) was the first to describe this syndrome and treat it endoscopically. For a bibliography up to 1951, see NELSON. He quotes 29 publications containing a total of 341 cases, to which he adds 123 of his own.

NELSON's review of the literature alone demonstrates the widely varying frequency with which this condition is reported. The majority of publications are concerned with a small number of individual cases.

The numbers involved reflect our own experience. In my 30 years of urologic practice I have only encountered a very few cases exhibiting the classical symptoms of this outflow disorder, although I initially encountered it during my first year as a urologist under MAY. After a considerable period of suprapubic drainage an elderly woman was restored by MAY (1957) to spontaneous micturition through repeated incision of the internal meatus in several sittings. This procedure was undertaken with a hook-shaped wire probe in the v. LICHTENBERG-HEYWALT resectoscope. A previous case was published by MAY in 1936.

My interest in such problems was therefore aroused, but nevertheless I have rarely come across such cases. These few observations contrast with case reports suggesting a far greater incidence. Thus POWELL and POWELL (1958) report 234, EMMETT et al. (1950) over 76, and NELSON 123 cases.

SMITH and KAUFMAN (1976) on the other hand consider the diagnosis to be made far too often, a criticism also cautiously voiced by ÜBELHÖR (1962).

The current section can therefore only be concerned with directing attention to this clinical picture and with the elaboration of criteria by which cases may be selected for surgery and with a corresponding assessment of the strict indications.

2. Symptoms of Female Bladder Outflow Obstruction

The clinical picture is very similar to that of bladder neck obstruction in the male. Suspicion therefore centers on the presence of this disorder whenever a women complains of poor urinary stream, frequency and prolonged duration of micturition. Considerable straining is required during urination. Acute retention is naturally suggestive of bladder neck stenosis, particularly if it frequently occurs. The most common symptom was that of recurrent urinary infection, this being the presenting symptom in 91.8% of the 234 cases presented by POWELL. Local treatment achieved transient improvement in every case. In the publication of POWELL and POWELL 'local treatment' encompasses urethral dilatation and coagulation of polypoid lesions around the bladder neck. 'Conservative treatment' is used by NELSON et al. to describe a wide range of treatments for cystitis, including the prescription of sedatives and urinary antiseptics, urethral dilatation and instillation of silver nitrate into the bladder. NELSON et al. do not consider the mere presence of bladder neck stenosis as such to be an indication for surgery, the latter only arising in the presence of typical symptoms. EMMETT et al. include a sudden urge for micturition and incontinence among the symptoms which may finally lead to this diagnosis. Note that these and other authors frequently quote symptoms which we consider to be typical hall-marks of cystitis. This is one possible explanation for the fact that a syndrome so rarely described by many authors is reported with such unusual frequency by others.

3. Diagnosis of the Disorder

The diagnosis of female bladder neck stenosis can only be made if every female patient complaining of one or more of the above symptoms is subjected to a full diagnostic assessment.

Apart from laboratory investigations, including complete bacteriological screening (urethra, vagina, urine), most clinicians would request an initial excretion urogram. Signs of advanced outflow obstruction, such as ureteric dilatation or hydronephrosis will then become apparent. Such changes are, however, extremely rare since the associated severe symptoms will usually have long resulted in the diagnosis being made.

a) Cystoscopy

In *typical* cases cystoscopy reveals a tough sclerotic ring around the internal meatus. NELSON et al. described this ring particularly clearly: it is best seen through a 90° telescope as the cystoscope is gradually withdrawn away from the trigone towards the exterior. During this maneuver the bladder neck will appear in the field of view *suddenly,* not in the typical gradual way seen in the normal tract. A forward-viewing telescope provides a different image: the bladder neck bulges up into view on all sides.

EMMETT et al. are somewhat more sceptical in their evaluation of cystoscopic findings. Far from there being a typical pathognomonic appearance, they believe that such a seemingly rigid sphincter is found with equal frequency in normal women. Apart from this typical sign of a fibrotic sphincter, whence the illness takes its name, they frequently find pseudopapillary tags and erythema of the mucosa as evidence of chronic inflammation, bladder muscle hypertrophy being a particularly important sign. This general picture is of high diagnostic value, occurring almost invariably in typical cases.

b) Urodynamic Investigations

Urodynamic studies may also be of considerable value, generating useful numerical data on the actual impairment of urinary flow, especially if measurements can be repeated serially. Ohm's law may be used to calculate bladder neck resistance from simultaneous measurements of intravesical pressure. The simplest way of establishing a reduction in urinary flow would be for the patient to measure the duration of micturition in seconds with a stopwatch and divide the volume of urine passed by the time elapsed. A slightly more complicated method requiring the availability of apparatus is the method of uroflowmetry, e.g., employing the uroflowmeter of TAMMEN developed in our clinic. The result is a curve corresponding to the quotient of urine volume and time (g/s).

In a typical case the curve will show periodic variations in urine flow with maxima, minima and intermittent complete interruption of urine flow. In the presence of true sphincter fibrosis most cases will display an increased bladder opening pressure. By measuring intravesical pressure through a transurethrally placed 5-Ch ureteric catheter, the resistence at the bladder outlet is easily derived electronically or by calculation. Since normal values have not yet been described in the literature this investigation alone is not capable of influencing the indications for surgery.

Sphincter fibrosis should be carefully distinguished from the functionally similar disorder of detrusor-sphincter dyssynergy, in which increased activity of pelvic floor musculature at the onset of micturition also results in high bladder opening pressures and poor flow rates. A pelvic floor electromyogram will nearly always make this differential diagnosis. The urethral pressure profile is also unhelpful in assessing operative indications, since this investigation often fails to yield reproducible results.

The diagnosis itself thus rests on rather uncertain foundations, and the woman's subjective symptoms may remain among the most important diagnostic factors. The variability with which these symptoms correlate with measurable values is a continuing source of surprise.

The cases we investigated had very considerably higher flow rates than one would suspect from the descriptions given of poor micturition.

c) Differential Diagnostic Considerations

In view of the discrepancy described above between individual reports on its incidence, the condition should only be diagnosed with the greatest caution. Since the diagnosis cannot be made on endoscopic criteria alone, careful exclusion of differential diagnoses is required.

Both neurological and gynecological factors should be carefully considered. Subtle neurological conditions such as early multiple sclerosis, myelitis, tumor, neurovascular disorders and diabetic neuropathy are rather more likely differential diagnoses than obvious gross traumatic disorders of the spinal cord and cauda equina. Nerve injury during eradication of carcinoma of the rectum or radical surgery for carcinoma of the uterus belong in the same group.

On the gynecological front, abnormal anatomy of uterus, vagina and bladder may give rise to a degree of retention, although incontinence is of course a far more common problem.

Drug-induced outflow disorders should finally be included in the differential diagnosis. Impaired voiding of urine is a well-known phenomenon in male patients on antihypertensive treatment, and atropine and its synthetic analogues used in the treatment of parkinsonism have similar effects. The influence of pharmacologically active substances on bladder outflow disorders is best tested by a transient interruption of the appropriate therapy.

4. Morbid Anatomical Change and Outflow Disorders of the Female Bladder

Various authors have failed to discover a specific abnormality of the bladder neck present in the majority of cases. EMMETT et al. provided no figures on the incidence of their histologic findings consisting of a cellular inflammatory reaction and granulation tissue. Hypertrophy of smooth muscle seemed to be dominant.

Inflammatory change is also the most frequent finding in the series of POWELL and POWELL.

The fibrosis of smooth musculature one might suspect from the name most frequently given to the disorder occurred in only 12.7% of all cases in the series of POWELL and POWELL. All in all, the histological findings variously reported suggest that one is not dealing with a precise, morbid anatomically defined disease, but rather with a syndrome of multifactorial etiology. The majority of these women should be considered as suffering from an acquired disease in the wake of previous pregnancy, urinary infection or gynecological surgery.

5. Treatment of Bladder Outflow Disorders

Nonendoscopic techniques such as dilatation and internal urethrotomy with the Otis knife are not further discussed here since they have no lasting influence on the actual disorder, i.e., the presence of a circular band of tissue around the internal meatus. Such 'blind' incision is the method of choice for distal urethral stenosis, particularly stenosis of the external meatus.

a) Transurethral Resection

The technique of transurethral resection at the internal meatus is basically simple, consisting of the removal of a circular tissue ring. The loop is engaged only superficially, and a fairly shallow layer is thus removed. There are two reasons for such a cautious approach:

1. Deep resection carries a risk of perforating the urethra.
2. Excessively deep and extensive excision may enter the proximal urethra with resulting incontinence.

Because of the risk of incontinence we have made it a rule in all our cases to risk repeating the operation rather than being too ambitious.

A more experienced surgeon will naturally proceed somewhat more boldly. The technique of resection is therefore fundamentally different from that in the prostate, where the main aim is nearly always to remove as much tissue as possible with the minimum number of cuts. The reverse procedure is required here. Thin shallow slices are first removed in a circular ring around the internal meatus. It is not infrequently adequate to confine a first sitting to the removal of polypoid pseudopapillary tags constricting the bladder neck; their removal in an almost cosmetic operation on the internal meatus frequently so smooths the area as to reduce the outflow resistance. With increasing experience one will come to recognize cases in which this ring of inflammatory tissue is more pronounced. One or two cuts may then be required to reach a tissue layer in which muscle fibers of the internal meatus are visible.

Hemostasis in this small clearly visible operative field is easy and follows the rules laid down for prostatic resection.

b) Postoperative Treatment

The indwelling catheter can usually be removed on the first postoperative day, and such a procedure is indeed advisable to prevent infection.

The success of operation usually becomes apparent after only a few days' observation as patients lose their fear of the initial postoperative pain and start to empty their bladders without hesitation. Particularly sensitive women should receive liberal analgesia in the first few days, possibly in combination with psychotropic agents.

6. Assessing the Operative Success Rate

The success of the operation may be easily assessed by uroflowmetry and residual volume measurements. If the results are inadequate, the operation may be repeated after 3–4 days.

Since surgery seldom takes longer than 10 minutes, anesthetic side effects are few. Because of its short duration we prefer to perform this operation under general anesthesia. Repeated epidurals would certainly be too invasive.

V. Resection and Prostatic Calculi

The calculi are formed within prostatic glandular tissue, rather than in the adenoma which thus pushes them peripherally towards the capsule. They then lie within the so-called surgical capsule and are only encountered as resection approaches the dorsal paracollicular region (see Illustrations 44 and 45, Plate VIII).

Prostatic calculi seldom present a problem during resection unless they are extremely large or if their bed and surroundings have undergone inflammatory change.

A large calculus occasionally represents an obstacle to continued resection, particularly if only its tip projects into the resection field. The larger bulk then remains firmly embedded in tissue. Its removal is sometimes facilitated by notching the immediately adjacent tissue. This is achieved by pressing the loop straight into the tissue to one side of the stone without any forward or backward movement, repeating the maneuver on either side. Calculi are occasionally so firmly embedded that the cutting loop is not strong enough to lever them out. A curet attached to the electrotome in place of the loop may be preferable. Sometimes calculi lie in large nests so that rectal pressure may expel several concretions simultaneously when their cavity has been incised. They are evacuated from the bladder in the irrigating fluid.

Once all calculi have been removed, the tissue in which they were bedded must be excised down to the prostatic capsule so as to restore a smooth wound surface.

It is always surprising how far distal to the verumontanum calculi may occur, underlining that the verumontanum is only a landmark, not an absolute boundary.

Great care should be taken whenever calculi are embedded in inflammatory tissue or even surrounded by microabscesses. In these cases incision of the cavity around a calculus releases a glairy secretion. Such cases should immediately receive a broad spectrum antibiotic intravenously to combat bacteremia, even if the preoperative urine was sterile.

Once again the floor of the prostatic cavity should be carefully dissected clear and all inflammatory tissue completely removed. The purpose of this is not 'cosmetic,' since a smooth wound cavity is far less prone to postoperative infection.

VI. Resection and Prostatic Abscess

Transurethral drainage of a prostatic abscess is rarely a planned procedure. Usually a previously undiagnosed clinically silent abscess is incised during adenomectomy. Intentional planned transurethral drainage has however recently become a routine method. It is contraindicated in young patients because of the danger of retrograde ejaculation, since it is impossible to predict preoperatively how much gland will need to be resected (see Illustration 42, Plate VII).

The procedure may however be recommended for the elderly and for patients who consent to transurethral drainage in the full knowledge of the possible sequelae. The technique is simple and obviously particularly attractive for abscesses in the immediate vicinity of the urethra.

Cystourethrogram and rectal palpation clearly indicate which side of the prostate is affected. A single incision is usually adequate to open the abscess as it bulges into the urethral lumen. It is then drained by moderate rectal pressure under gentle irrigation. Once clear visibility is re-established the not infrequently loculated abscess cavity is inspected and the incised opening extended and smoothed. Rectal palpation should exlude the presence of an additional separate loculus requiring additional drainage. The procedure takes but a few minutes, and an indwelling catheter is left in situ 1–2 days. The abscess cavity may continue to bleed and catheter patency should therefore be tested by careful irrigation in the postoperative period. The entire procedure is naturally carried out under antibiotic cover.

Transurethral surgery is not indicated for patients whose abscess is pointing towards the rectum and in whom there is little or no bulge into the prostatic urethra. Such cases are better treated by perineal drainage. *Under no circumstance* should cases of acute suppurative prostatitis be subjected to a transurethral procedure, be it for diagnostic or therapeutic purposes.

Abscesses should be distinguished from cases in which inspissated secretion oozes from the transected glands in a process similar to squeezing toothpaste from the tube. Secretion of a similar consistency escapes from cavities within the gland as they are transected. Pressure from the rectum may accelerate this process. Since we have never proved infection in a single such case, it is reasonable to assume that the substance is inspissated glandular secretion or the contents of an old inactive abscess. Once the secretion has been evacuated the wall of the cavity may be inspected and excised. Illustration 42 (Plate VII) shows this material oozing out of a cavity.

VII. Resection and Chronic Prostatitis

In our experience only a few cases are suitable for this form of treatment. It is far more frequent for inflammatory and obstructive symptoms to blend imperceptibly. One reason may be that the connective tissue reaction involved in chronic inflammation can give rise to a kind of secondary bladder neck fibrosis.

Even as a last resort it is not an easy decision to advise a patient with chronic inflammation to undergo transurethral removal of inflamed and infected prostatic tissue. I have only rarely come across indications for this procedure, the chief one being recurrent failure of conservative treatment, including high-dose intravenous antibiotic therapy over several weeks. A prior proctological and psychotherapeutic assessment should also be made to exclude either realm as a source of symptoms. Examination of ejaculate and expressate should reveal high bacteria and leucocyte counts.

The diagnosis is finally confirmed by cytological and histological examination of aspiration and punch biopsy materials. Many of these patients suffer recurrent episodes of fever requiring antibiotic treatment.

Operation requires considerable technical subtlety, since success will depend on the removal of all infected gland tissue leaving only the fibromuscular capsule. The technique is identical to that for bladder neck fibrosis (see p. 340) and is therefore not described again at this stage. Local findings may be of interest: transected glands are often rich in secretion and occasionally contain microabscesses. In between there may be areas of complete, normal-looking glandular tissue in which only the pathologist will detect inflammatory change.

Once again the procedure should be undertaken under antibiotic cover and followed by prolonged postoperative anti-inflammatory therapy.

The results are not always as good as patient and surgeon expect, even if infection is completely controlled. This is one good reason for restraint in recommending the procedure.

VIII. Resection and Prostatic Tuberculosis

In the last 20 years I have never come across this indication for surgery. The chief reason must be that urogenital tuberculosis is nowadays exceptionally rare. The second reason is that surgery may be even less indicated than in chronic prostatitis.

The few cases we operated on in the 1950s all had proven cavities within the organ, and surgery was performed in order to improve their drainage and healing.

IX. Palliative Resection

This procedure is aimed at patients who are fundamentally inoperable for non-urological reasons, subjecting them to the minimum operation required to rid them of their indwelling catheter. Such 'miniresection' used to be rarely indicated, and is even less so nowadays since the availability of cryosurgery. This has a variety of reasons:

1. Rapidly executed complete adenomectomy is hardly more invasive for the patient than the excision of a urinary channel through the adenoma.
2. Incompletely removed adenomas rapidly lead to renewed deterioration of micturition, since recoil in the capsule makes the soft tissues bulge back again into the urethral lumen.
3. In patients with prostatic carcinoma further advancement of the growth leads to rapid deterioration of micturition unless a large wound cavity is excavated.
4. The poor blood supply of a partially resected adenoma is often responsible for recurrent infections and tiresome dysuria.
5. Cases in which electroresection is absolutely contraindicated, e.g., those with severe cerebrovascular disease, are equally untreatable by palliative resection or cryosurgery.
6. Patients with severe cardiovascular disease can nowadays be treated without anesthesia by cryosurgery.
7. Cases of large adenoma will require the removal of large quantities of tissue even for palliative resection and are therefore not suitable for this method.

The latter is thus reserved purely for cases of medium adenoma of 20–30 g in complete retention who are marginally fit for anesthesia. Often, anesthetist and internist advise the shortest possible procedure.

We carry out palliative resection in the same fashion as a normal adenomectomy, but desist from complete clearance of the capsule. An adequately large wound cavity is created but remains lined by a layer of adenomatous tissue. Careful resection of the prostatic apex is indispensable for proper micturition. The operation usually takes approximately 15 to 20 min including hemostasis and the blood loss is seldom more than 50 or maximally 100 ml.

One must work rapidly and with full concentration.

X. Electroresection in Patients with Cardiac Pacemakers, Artificial Heart Valves or Vascular Prostheses

By W. Schütz

There is both intraoperative and experimental evidence that the use of electrocautery during surgery may interfere with the function of pacemakers, resulting in bradyarrhythmia, asystole or ventricular fibrillation (Ackermann and Frohmüller 1976; Fein 1967a, b; Greber et al. 1970; Greene et al. 1969; Greene and Meredeth 1971; Lichter et al. 1965; Schütz 1979; Schwingshackl et al. 1971; Sowton et al. 1970; Wajszcuk et al. 1969; Whalen et al. 1964; Zink et al. 1980).

For this reason transurethral electroresection in patients with cardiac pacemakers requires certain pre-, intra- and postoperative measures to be taken for the early recognition and avoidance of complications.

Preoperative measures include identification of the type of pacemaker, checking its function and testing the state of charge of its batteries. Asynchronous fixed frequency pacemakers are generally insensitive to external high-frequency current, but the reverse is true of the far more frequently implanted synchronous demand pacemakers: P-wave synchronized and R-wave triggered demand pacemakers may increase their rate under the influence of high-frequency current, albeit only up to a limiting rate given by the pacemaker refractory time. R-wave inhibited demand pacemakers on the other hand only emit an impulse if the spontaneous heart rate sinks below a predetermined value. Where a slow intrinsic heart rate is assisted by this type of pacemaker high-frequency current may simulate cardiac activity and thus inhibit the pacemaker. The result may be bradycardia or complete cessation of pacemaker activity.

During the operation pacemaker activity should be monitored on high-frequency-proof ECG equipment (Fig. 219), the advantages of which are described below. If satisfactory monitorng is not available, the pacemaker should be switched to fixed-rate operation by applying a small bar magnet to the skin over the pacemaker. The pacemaker is then rendered insensitive to external high-frequency interference. On the other hand, interaction of spontaneous car-

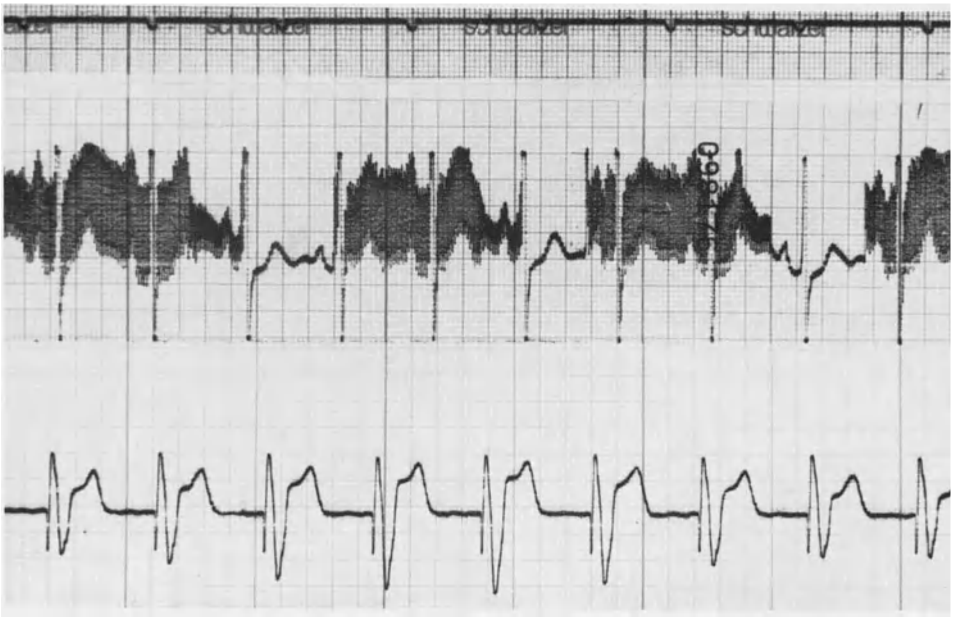

Fig. 219. *Above:* Obvious interference with the ECG by high-frequency current. *Below:* Unimpaired pacemaker ECG recorded on a cautery-proof monitor

diac rhythm and autonomous pacemaker activity may result in undesirable hemodynamic effects.

Pacemaker patients have a limited ability to compensate for a reduction of circulating volume as a result of intra- or postoperative hemorrhage: pacemaker assistance of a slow idioventricular rhythm results in a preprogramed rate rather than in that physiologically required. Careful fluid balance is therefore indispensable and early generous blood replacement always indicated.

Pacemaker and resection circuit are less likely to influence each other the further apart they are physically separated. The indifferent electrode should therefore be placed at least on the distal thigh. If these requirements are satisfied we consider the additional implantation of a second extracorporeal pacemaker to be unnecessary. Cables in the pacemaker and resection circuit should not be allowed to lie parallel so as to avoid induction effects.

Experimental and operative studies have both shown that inhibited pacemakers are most susceptible to interference at the time of switching high-frequency current on and off (Schütz 1979; Zink et al. 1980), whereas regular, undistorted pacemaker pulses continued to appear on the monitor during the cutting and coagulating process. Cautery-hardened monitoring is therefore of advantage, since the surgeon will immediately become aware of dysrhythmias and be able to modify his technique accordingly, usually in favor of a less rapid cutting sequence with longer individual cuts.

Nevertheless the availability of a defibrillator in working order within easy reach of the operating room remains a fundamental requirement: Transients

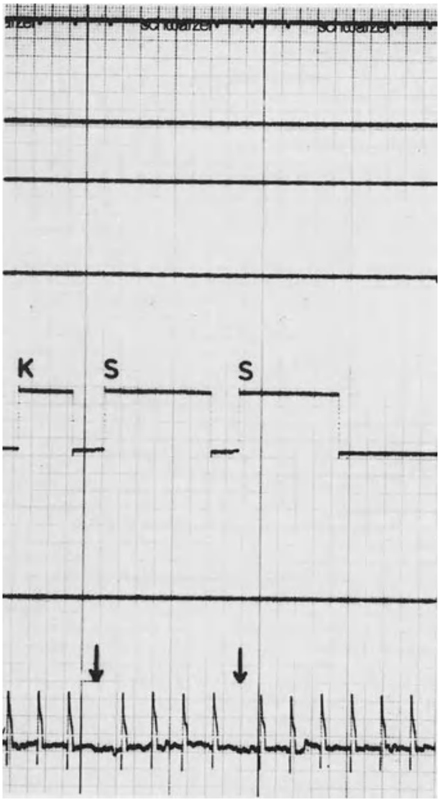

Fig. 220. Inhibition (↓) of the pacemaker by switch pulses from a high-frequency generator. Spontaneous pacemaker activity during a cutting phase (*S*). In the ECG shown here coagulation (*K*) falls within the refractory time of the pacemaker and thus does not give rise to inhibition

of over 20 V during a vulnerable phase of the cardiac cycle may lead to ventricular fibrillation (Ackermann and Frohmüller 1976; Greene et al. 1971). Pacemaker function should again be checked in the postoperative phase, since pronounced battery exhaustion has been described following the use of high-frequency current (Schwingshackl et al. 1971).

The danger of specific complications should be carefully considered prior to transurethral resection in patients with artificial heart valves or vascular prostheses: thrombosis or embolism, infection (endocarditis) and acute heart failure due to volume overload. Preoperatively such patients are frequently on long-term anticoagulant therapy. On the day of resection thromboplastin activity should not be less than 60%. This generally requires interruption of anticoagulant therapy but an internist's advice should be sought in every case. The clotting status must be estimated daily and the earliest possible postoperative recommencement of anticoagulation aimed for.

Because of the additional infection rate, perioperative antibiotic cover is indicated even in previously uninfected patients. Established urinary infection should be treated as far as possible preoperatively. Postoperative pyrexia is an absolute indication for blood culture.

The entry of irrigating fluid into the system during transurethral prostatic resection is a special hazard to patients with artificial heart valves, since they are far more susceptible than normal patients to acute cardiac decompensation in the wake of volume overload. Peroperative circulatory monitoring therefore attains special significance. Transection of a venous sinus must be followed by immediate conclusion of the procedure, so as to minimize the inadvertently infused. In these situations sodium-excreting diuretics (e.g., frusemide) are superior to osmotic agents, since the latter will transiently increase the intravascular volume. Plasma sodium estimation immediately prior to and after operation will give a good idea of the extent of irrigation fluid infusion. A variation of more then 10 mEq/l between the two values suggests the absorption of considerable volumes (MULCAHY et al. 1975).

Transurethral resection carries an increased operative risk in patients with cardiac pacemakers, artifical heart valves or vascular prostheses, and should therefore be reserved for experienced surgeons.

XI. Resection for Impaired Micturition Following Rectal Surgery

Disordered micturition, if not actual acute retention, frequently follows in the wake of rectal surgery. Three causes may be considered for this phenomenon:

1. The operation may have extensively denervated the bladder. Complete or partial nerve section may reduce detrusor activity.
2. The bladder falls back into the hollow of the sacrum.
3. Postoperative bedrest and the proximity of a wound and surrounding edema are frequently enough to precipitate problems in elderly patients with incipient but clinically silent prostatic adenomas.

There is probably most often some combination of these causal factors.

Electroresection is the method of choice for the treatment of these disorders. The problems are similar to those relating to resection for neurogenic bladder and bladder neck fibrosis: some cases may require extensive surgery to restore the balance between the detrusor and the bladder neck resistance. Refer to the description of resection for bladder neck fibrosis and bladder atony.

XII. Resecting Papillary Tumors of the Prostatic Urethra

Epithelial tumors of the urethral mucosa are rare, but the technical problems to which they may give rise are discussed in the following (see Illustration 17, Plate III).

Isolated 'papillomas' and papillary carcinomas of the prostatic urethra are easily treated by simple excision with a few cuts. Because of the large quantity of surrounding tissue available for dissection in depth, such procedures have a good chance of achieving radicality. The only price will be partial removal of the adjacent prostate.

Total papillomatosis of the prostatic urethra is a considerably more problematic state of affairs. Not only is all tumor-bearing mucosa to be removed, but electroresection should proceed down to the capsule as for adenomectomy. The chief problems arise at the distal and proximal ends of the prostatic urethra: the proximal transition to the bladder must be carefully inspected, since the tumor not infrequently crosses the internal meatus to involve bladder mucosa. Distally great care and occasionally an extremely shallow cutting technique is required to avoid injury to the external sphincter. Particular difficulty may arise where the tumor reaches down to or beyond the verumontanum. Superficial and deep tissue samples from this area should be sent for separate histologic analysis. This will be the only guide to the requirement for further deeper resection at a second sitting. Fortunately, the majority of these tumors are mainly exophytic and have a limited tendency to infiltrate.

XIII. Resection of Bladder Diverticula

Suprapubic excision is indicated for very large diverticula, particularly in the presence of a very large adenoma. The combination of small adenoma and large bladder diverticulum is treated by initial open exicision of the diverticulum followed 8–10 days later by resection of the adenoma.

The current section is more concerned with the problems of resection in the presence of a diverticulum and with transurethral surgery to the diverticular neck.

Two points should be borne in mind during resection of prostate and bladder diverticula:

1. Complete evacuation of resection chips from the diverticulum or diverticula
2. The deepest possible incision of the diverticular neck where this is narrow, so as to widen it and, ideally, convert the diverticulum into a new area of the bladder wall (see Fig. 218).

XIV. Resection and Bladder Calculi

We undertake litholapaxy and electroresection of prostatic adenomas at a single session, depending on the indications. The bladder neck configuration and depth of the retroprostatic recess will decide which of the two procedures is carried out first. If the calculus is easily reached, litholapaxy is not delayed. If, on the other hand, a large median lobe bulges into the bladder or a very deep recess suggests difficult access to the calculus, the adenoma is first removed and litholapaxy reserved until the end of the sitting, the main requirement being adequate hemostasis during resection. Since introducing our punch lithotripe we have no longer had any of the traditional problems in finding residual calculus fragments. This instrument allows a systematic procedure under first-rate visiblity even in the presence of hemorrhage.

XV. Resection of Bleeding Adenomas

Hemorrhage usually originates in the superficial mucosal veins of the prostatic urethra and is to a great extent promoted by the poor venous drainage of large adenomas. It occasionally takes on such threatening proportions as to demand action.

We are not concerned with sporadic mild bleeding. This always demands careful investigation of both upper tract and bladder but seldom requires any active procedure.

The endoscopic appearance of severe hemorrhage is unmistakeable. The mucosal veins are usually dilated, occasionally to the extent of true varicosity, i.e., they are wide, tortuous and easily ruptured. The source of bleeding is most easily found under reduced irrigation. If one attempts to close the veins by direct coagulation one merely succeeds in crusting over the area but bleeding occurs immediately alongside, usually more profusely. It is a matter of experience with many similar cases that coagulation only rarely yields results and only immediate resection will provide a definitive solution to the problem (Nesbit 1943).

Many such patients are admitted to hospital with bladder tamponade and retention of urine. Attempts at evacuating the tamponade by catheter usually fail, and rapid operative intervention is then indicated.

Under general anesthesia, or epidural if the patient is not starved, the clots are first evacuated and an attempt is made at arresting the hemorrhage by coagulation. In this emergency situation not more than 10 min should be spent on coagulation. If hemostasis has not been achieved by then we immediately follow on with resection, palliative or complete depending on the patient's condition and the size of the adenoma. Adenoma tissue is resected until a tissue layer is exposed allowing easy coagulation. This will be the case when the entire mucosa surrounding the bleeding area and a layer of 2–3 loop thicknesses has been ablated. Bleeding arteries and veins around the margin of the resection area are then coagulated. Once the patient has fully recovered and has been prepared for surgery in the usual fashion, the operation may be concluded. If the patient's general condition permits and the adenoma is not too large we undertake resection in the usual fashion.

XVI. Resection in the Presence of Bladder Tumor

The resection of bladder tumors and prostatic adenomas in the same sitting is without further problem. One occasionally hears warnings against this procedure on the grounds that metastases may be implanted in the prostatic wound cavity. In 25 years of practicing this combined technique we have never observed a single case which would justify such reservations.

The coincidence of bladder tumor and adenoma is not particularly rare, occurring in 7% of our patients.

We usually start by removing the adenoma, the reason being that resection of bladder tumors on the lateral wall of the bladder and in the vault is considerably facilitated by an empty prostatic cavity. The instrument is more mobile and these regions of the bladder are more easily seen. In some cases the removal of tumors from the vicinity of the internal meatus is only rendered possible by simultaneous prostatic resection. This may even be true of an unenlarged prostate rather than an adenoma. Tumors around the internal meatus invading the prostate require extensive prostatic ablation. The tumor prognosis is thus greatly improved because deep resection of prostatic tissue benefits the radicality of the procedure. These deep tissue layers should be dispatched separately for histologic examination.

XVII. Resection Following Open Adenomectomy

Enucleative surgery is occasionally followed by postoperative problems easily amenable to transurethral correction. Mention has already been made in Chap. F of hemostasis within the cavity (and along the bladder incision following transvesical operations).

Endoscopic inspection is indicated whenever the patient experiences difficulty in micturition after enucleation of an adenoma, or when there is marked pyuria. Areas of tissue necrosis may be found and resected. Encrusted necrotic tissue debris may also be removed in this fashion. Occasionally the HARRIS-RHYNTSCHAK hemostatic suture does not dissolve spontaneously and needs to be divided by transurethral resection.

The transurethral surgeon is always impressed by the appearance of the wound cavity after enucleation. One tends to assume there will be an entirely smooth surface since this is the impression that presented itself to the finger at operation. The truth is quite different. Endoscopic examination reveals an irregular cavity covered in a ragged coating.

In a few cases where patients had a poor urinary stream following enucleation we were able to resect mucosal remnants from the paracollicular region.

A separate section is devoted to the resection of iridiform bladder neck stenosis which may result from either endoscopic or enucleative surgery (see p. 389).

Chapter I

Litholapaxy

I. Preliminary Considerations

No single transurethral operation has undergone quite such a fundamental change in the last two decades as litholapaxy. As recently as the 1940s and 1950s blind litholapaxy by the Bigelow lithotrite was a common procedure in a number of clinics. Nowadays both instrument and method are known only to a few older urologists and their pupils. A variety of technical factors are responsible for this development: destruction of bladder calculi by the Urat-I instrument has had a particularly revolutionary effect. Ultrasonic litholapaxy has only recently reached technical maturity. Subdivision and extraction from the bladder of calculus debris has been so simplified by the introduction of the punch lithotrite that the latter is likely to remain the standard technique for many years to come. Only the basic concept just outlined will be further discussed in this operating manual.

II. Preliminary Assessment of the Patient

All patients undergoing a urologic operation receive a full general medical and urological workup. Because of their decisive influence on the relative indications for surgery, particular importance attaches to the magnitude of calculus and adenoma. Even the experienced surgeon occasionally has difficulty in estimating the size of a calculus on endoscopic examination, and misinterpretations not infrequently arise. The endoscopic findings should therefore always be underpinned radiologically, and attention must be drawn to the techniques of air and contrast cystogram, allowing excellent demonstration of nonopaque stones.

This imaging technique is even capable of distinguishing the type of calculus involved, at least to the point of identifying soft phosphate calculi. The presence of the latter may represent an additional indication for transurethral treatment since their soft consistency renders them eminently destructible despite considerable size.

III. Indications

Bladder calculi nearly always occur in combination with prostatic adenomas and are excessively rare in women. The etiology frequently includes foreign bodies which become encrusted. In the male patient it is mandatory to treat both calculus and adenoma, since there will otherwise be numerous calculous recurrences. These remarks do not of course apply to phosphate calculi relating to previous infection or to foreign bodies.

In the presence of an outsize adenoma best treated by enucleation the calculus may be removed during the same operation. Cystotomy alone is only indicated in cases where particularly large calculi occupying the entire bladder require emergency removal, although cases of this kind have nowadays become extremely unusual. The requirement for access to all aspects of the calculus is the only factor imposing an upper size limit on the transurethral approach. A small bladder may be a more serious obstacle than a large stone. The old rule that the calculus should be smaller than the mouth of the lithotrite is no longer valid, but it should still be carefully considered whether open removal of a very large stone (4- to 5-cm diameter) and a moderate adenoma is not still the less invasive procedure for the patient. Quite apart from such considerations of size, importance attaches to the surgeon's experience and personal preference. It is a well-known fact that while soft outsize stones are easily and rapidly removed by the transurethral route, extremely hard, quite modest stones may represent very considerable problems. The effect on the urethra should also be borne in mind. A narrow, strictured urethra will speak strongly in favor of open rather than transurethral surgery.

In summary: there are no fixed and generally binding rules, although modern endoscopic techniques have further shifted the balance in favor of transurethral therapy.

IV. The Technique of Litholapaxy

1. Preliminary Considerations

It is not proposed to discuss blind litholapaxy with the Bigelow or some other blind instrument in this operation manual, although I personally still occasionally use such methods. With a few exceptions the more modern Urat-I and ultrasound techniques have led most of our younger colleagues to abandon the traditional method, since operation under direct vision is both easier and more rapidly learnt.

Until recently the Urat-I procedure was the only one allowing the comminution of larger calculi under direct vision. The various technical problems associated with ultrasound litholapaxy have now been satisfactorily solved and I therefore personally prefer this method for the destruction of calculi, since it avoids most of the electrical problems and dangers involved in the shock-wave technique. Numerous clinics will still possess Urat-I apparatus, and both techniques are therefore described below. Which ever method of initial destruction is chosen, final comminution will require the use of a mechanical lithotrite. In 1976 I developed my punch lithotrite, which provides an ideal solution to this problem even under conditions of the very poorest visibility (MAUERMAYER and HARTUNG 1976).

2. Ultrasound Litholapaxy

The extensive use of ultrasound techniques in industry had long suggested their employment in the destruction of bladder calculi. It has taken some time to achieve a practical solution.

The 'Aachen' model of ultrasound apparatus now available is technologically mature and renders the destruction of bladder calculi considerably simpler than did the Urat-I instrument. Its chief advantage is the way in which the calculus remains immobile in the base of the bladder, rather than having to be looked for every time it is hurled around by a spark discharge.

a) The 'Aachen' Ultrasound Lithotrite

The instrument consists of three functional units: the endoscopic instrument proper, the ultrasound generator and the evacuation device.

α) The Endoscopic Instrument. This consists of a metal sheath and the LUTZEYER operating element. The metal sheath of a punch lithotrite is used with its central stopcock, since this permits complete evacuation of concretion material without a change of instrument.

The operating element is locked into the sheath just like the electrotome of a resectoscope. For structural reasons the optical system needs to be angulated, and a special eccentric telescope is therefore provided. Its optical data are those of a 0° HOPKINS system.

An ultrasound drill runs parallel to the axis of the instrument and is activated by oscillations of the ultrasonic transducer. Drill and transducer crystal (actually of ceramic type) contain a central bore through which irrigating fluid, small fragments and drill swarf are evacuated. A connector on the instrument accepts the evacuator hose. A simple mechanical lever system allows advancement of the operating unit, extending the drill from the sheath and bringing it into contact with the concretion. The ultrasound drill is fitted with a kind of 'crown' freely rotating on the transmission tube.

The following connections have to be made to the instrument:

1. Irrigation inlet
2. Irrigation drain (both controlled by central stopcock)
3. Evacuator hose

4. Light lead
5. High frequency excitation current to the transducer

The three water connections are made by a simple push fit to the instrument. The light connection is the standard type employed by the manufacturer.

β) The Ultrasound Generator. A high-frequency generator is used to produce electromagnetic oscillations of 27 kHz. A cable connects the generator to the transducer. Although the actual electronic process within the generator is considerably more complicated than suggested here, the simple facts just given are adequate for day-to-day use.

γ) The Evacuator. The central bore of the operating unit permits the evacuation of small particles and of swarf. Irrigating fluid simultaneously cools the transducer, the evacuator pump being controlled by a footswitch. Activating the switch simultaneously energizes the pump and the high-frequency generator, thus inevitably linking drilling with evacuation and cooling.

b) Technique with the Ultrasound Lithotrite

The operative technique is simple. The drill crown presses the concretion against the bladder wall, and after a more-or-less prolonged period of such 'hammering' the calculus disintegrates, frequently along several fracture lines. Care should be taken to allow the drill bit to 'hammer' rather than exerting so firm a pressure on the calculus as to reduce the amplitude or stroke of the drill.

Particularly helpful is the fact that fragments always remain in the bottom of the bladder. Only the smallest particles may be washed away by the irrigating current. Even if the drill bit comes into contact with the bladder wall, no injury will result. By attacking the edge of small concretions chips may be broken off which will pass through the central instrument lumen. When dealing with larger stones it is advisable to first excavate a small crater whence bursting of the calculus is more easily induced. The resulting fracture planes permit further comminution more easily than rounded surfaces.

With a little practice it is quite easy to teach oneself this technique.

To save time I would recommend that the ultrasound drill only be used for initial destruction of the concretion, and that this be continued with the punch lithotrite.

The chief advantages of this technique over the Urat-I instrument are undoubtedly the relatively insignificant danger of ultrasound and the fact that concretions remain immobile in the base of the bladder. I have never encountered hemorrhage due to mucosal injury.

It is advisable to keep the evacuator pump in operation even during drilling intervals, since cooling of the crystal will then be maintained. Water in- and outlet must be controlled by the central stopcock, so as to avoid excessive distension or emptying of the bladder. This is easily monitored under direct vision.

3. Urat-I Litholapaxy

a) Apparatus

The instrument consists of an electrical generator providing a high-tension supply. A footswitch triggers current pulses reaching the operating probe via a well-insulated twin lead and 2 pole connector. The flexible probe has a diameter of 10 Ch and can thus be inserted into the bladder through any operating cystoscope having a suitable channel.

b) The Probe

The probe basically consists of coaxial cable; an inner core and a thin metal outer tube are separated by an insulating layer. The whole probe is then encased in an elastic and mechanically resistant plastic sheath. On the application of high tension a spark discharge occurs between the two conductors, resulting in electrohydraulic waves which form the basis of the technique. For proper operation the tip of the probe should be carefully serviced. After every use it should be carefully honed flat on a fine grain stone, since every discharge burns off a small proportion of each conductor. Poorly conducting oxide films also inhibit discharge. Honing is most easily carried out on a small electrical grinding wheel. The probes may be sterilized by ethylene oxide.

c) Hazards of the Technique

The method is not without dangers, but complications may be avoided with proper care.

Electrical safety regulations should be strictly adhered to (local technical standards authority!). The instrument should be grounded and the operating table connected to this same ground point. Any malfunction in the equipment should lead to immediate abandonment of the procedure. In larger units it is therefore useful to have backup equipment.

The front lens of the telescope should never be allowed to come too close to the probe. The result may be loosening, or even worse fracture of a lens.

The energized probe should never be allowed to touch the mucosa, since bladder trauma would inevitably occur.

Finally, small splinters of calculus may penetrate the mucosa, although I have never seen any adverse result of this for the patient.

d) Anesthesia for Pressure Wave Litholapaxy

The procedure should be carried out under general or regional anesthesia. Since it will usually be followed by electroresection, the latter will probably govern the type of anesthesia chosen. Local anesthesia of bladder and urethra alone is not suitable for this operation, although it may suffice for ultrasound litholapaxy.

e) Instruments for Pressure Wave Litholapaxy

α) The Operating Cystoscope. The procedure may be undertaken with any operating cystoscope having a 10-Ch instrument channel. The problem of evacuating debris then remains to be solved, and may present great difficulties with these instruments, since the calculus will have to be reduced to fragments corresponding to the sheath caliber. Furthermore, evacuation is then blind, although a cystoscope sheath may be adequate for small calculi.

β) The Resectoscope Sheath. Since litholapaxy is nearly always coupled to prostatic resection, comminution of the debris could also be carried out with a suitable operating unit inserted in the resectoscope sheath.

γ) The Punch Lithotrite. A simple modification allows the punch lithotrite to be used for pressure wave litholapaxy. All that is necessary is the introduction of a control tube for the Urat probe in place of the forceps. The technique of litholapaxy remains the same as when using a resectoscope sheath or ordinary operating cystoscope.

Ultrasound litholapaxy may also be undertaken through the punch lithotrite sheath if the instrument is adapted to fit it. The ultrasound lithotrites and punch forceps now available are fully interchangeable.

f) The Technique of Electrohydraulic Litholapaxy

Attention has already been drawn to the hazards of the method, but they are repeated here: any contact between probe and bladder mucosa is absolutely to be avoided. During the initial phases this hazard is small but increases substantially towards the end of the procedure, as fragments become smaller and smaller.

Once again, the technique is simple and easily learned. The probe is brought into intimate contact with the calculus and current applied by means of the footswitch. Small calculi are occasionally thrown away from the probe by the spark discharge. For this reason the probe should always exert a certain amount of pressure on the calculus against the bladder base or posterior wall. Current pulses should never be applied to the calculus for too long at a time, and it is better to work with short bursts of pulses. The first sign of any effect is superficial flaking of calculus material at the point of contact, subsequently resulting in the emergence of a small pit or crater. It is wrong to then repeat the same process elsewhere. After a short pause allowing for the drainage of irrigating fluid the probe is again closely applied to the same point and repeatedly energized until the calculus disintegrates. Soft stones may do so during an initial series of discharges, but harder calculi will require more patience. If no effect at all is seen, either a different area of the calculus should be attacked or the pulse repetition frequency altered. Alterations in current intensity may also be tried. Since no concretion has a completely smooth surface, one of the many pits or depressions should be chosen as an initital point of attack on resistant calculi. Generally speaking, calculi disintegrate far more readily than this text would suggest.

For further comminution of fragments it is preferable to apply the probe to fracture planes rather than the curved external surface. It is rare for litholapaxy of a plum-sized stone to take more than 10 min. The smaller the fragments become, the greater their tendency to be hurled away by the current. Pressure wave litholapaxy should therefore be discontinued when the fragments have reached the size of a cherry or plum stone, and punch litholapaxy should then ensue in the usual fashion as described below. Whenever a substantial amount of loose debris accumulates it should be evacuated.

4. The Punch Lithotrite

This instrument has been specially designed for litholapaxy either by the purely mechanical route or in combination with pressure waves. The principal normally employed for 'punching' out portions of tissue has been specially adapted for this purpose and suitably rigid and robust mechanical construction has for the first time allowed its application to the destruction of concretions.

The instrument is introduced with an obturator to close its vesical end. The external end bears the usual central stopcock allowing control of irrigation in- and outflow even with the forceps in situ. After removing the obturator the *closed* operating element is introduced under maximum irrigation: great emphasis attaches to the instrument being closed, because the forceps are open in the resting condition and the cutting internal member therefore projects into the bladder. The forceps should therefore only be opened after direct vision has been achieved.

Small calculi up to the size of a hazelnut are easily gripped in the forceps, pressure wave or ultrasound litholapaxy then being unnecessary. Larger concretions may require their preliminary use. The irrigating behavior of the punch lithotrite has certain special features. If the internal cutting element is somewhat withdrawn into the sheath it may be seen that even in the presence of cloudy or blood-stained urine excellent visibility is maintained, although this deteriorates as the forceps are extended. Air bubbles occasionally become trapped in the forceps and cannot be carried away by the irrigating current. They are easily dealt with by rotating the forceps through 180° under maximum irrigation or by evacuating them through the central stopcock.

Heavily blood-stained bladder contents not cleared by normal irrigation require that the calculus be looked for with the inner forceps somewhat withdrawn into the sheath. Once the calculus has been found, the forceps may be briefly opened to seize it.

Engaging the calculus is easy. The open mouth of the forceps is applied to the stone and the jaws closed. Either a piece is punched out of the concretion and withdrawn into the sheath or the calculus simply fractures if pressure is relaxed at the correct moment. Equally a fragment may splinter off. One should always seek to apply the forceps across an edge or a projection, this will allow the deepest engagement into the mouth of the instrument. In the presence of several calculi frequent evacuation of debris will facilitate the recognition of individual large fragments.

5. Technique of Evacuation

Evacuation is best achieved by holding the sheath aperture as close as possible to the fragment. Since the latter tends to lie in the base of the bladder, the end of the tube could be approximated under direct vision to the bladder base and the main collection of debris, enabling the latter to be washed out on rapid evacuation of irrigating fluid. If the bladder floor is too closely approached it may become sucked against the aperture and close it off. In our experience therefore the most suitable device is one by which only small quantities of fluid are shifted but which nevertheless picks up fragments. These requirements are best fulfilled by the Ellik evacuator, the rubber bulb of which permits quite gentle pumping movements. At the same time, the sheath aperture is translated from side to side across the bladder floor, as the sweeping movements of a broom. After a series of such movements the Ellik evacuator is disconnected and the working element of the punch reintroduced. The bladder floor is then observed under *gentle* irrigation. The latter is necessary to prevent fragments and swarf being washed up out of the field of view.

Further calculous debris is commonly found in the lateral parts of the bladder base. The evacuation process is repeated with the sheath directed towards the main collection of debris.

Not infrequently this evacuation of minor fragments leaves a few larger chunks behind which are too large to pass the sheath. They require further comminution by the punch. The procedure is finally brought to an end by inspecting the floor of the bladder under virtually no irrigation. All that remains on the bladder base is a thin layer of coagulated protein, probably fibrin, in which fine swarf is embedded. This layer separates spontaneously. Final inspection should also detect any mucosal injury and search for calculous debris in diverticula or pseudodiverticula. This final inspection is usually followed by adenomectomy.

If the resectoscope sheath was used for Urat-I litholapaxy, bladder curets may be conveniently used during evacuation of the debris. These robust wire loops are fitted in place of the cutting loop on the electrotome and used to push debris up into a pile. The sheath is then held at this position and the electrotome removed, so that the outflow of irrigating fluid carries with it the majority of the residue. Large Pieces can be drawn into the sheath by the curet and then extracted together with the electrotome. Any instrument with a central stopcock may be equipped with an Ellik bulb in the drainage hose, as used in the resection of large adenomas. This obviates the requirement for repeated filling of the evacuator and its attachment to the instrument. Under direct vision the area of greatest debris accumulation is sought out and the opening of the instrument directed towards it. This position is maintained and the electrotome or punch unit withdrawn so as to allow gentle pumping movements to evacuate the remaining debris. Calculous fragments then come to rest in the collecting sieve.

6. Difficult Litholapaxy Due to Anatomical Factors

Technical difficulties may arise during litholapaxy whenever the bladder floor is deeply depressed, i.e., when there is a deep recess. Equally a markedly protuberant median lobe may obscure the view. Quite frequently a combination of both factors may be present.

Marked head-down tilt of the operating table may help in this situation. The calculus or calculi then roll away from their previous position close to the internal meatus and come to rest on the posterior wall. They must be followed in that direction by further advancing the instrument. Sometimes even extreme Trendelenburg will *not* solve this problem, and in these rare cases it may be necessary to carry out electroresection prior to litholapaxy. I would caution any less practiced surgeon against this procedure, since it requires great experience. The first requirement is for absolutely first-rate hemostasis in the prostatic capsule, and even then litholapaxy will have to be undertaken under somewhat reduced visibility. I myself was brought up in the era of blind litholapaxy, and in such cases I tend to use a blind lithotrite, subsequently comminuting and evacuating fragments with the punch. To replace shock wave litholapaxy by a blind procedure is certainly an acceptable alternative for urologists conversant with the method.

Increased hemorrhage during electroresection in the wake of previous litholapaxy is a recurring clinical suspicion, the fact of which we have not been able to prove.

7. Postoperative Care

Postoperative care differs not at all from that required for prostatic surgery on its own. The two procedures are usually carried out in combination.

In cases where, at the express wish of the patient, litholapaxy was undertaken on its own and where the stone was small, one may attempt to leave the patient without a catheter. Even so, there will still be some risk of acute retention. All patients should therefore receive antiinflammatory and antibiotic treatment prophylactically, irrespective of the duration of catheterization.

Chapter K

The Zeiss Loop and the Placement of Indwelling Ureteric Catheters

I. Extracting Ureteric Calculi with Endoscopic Instruments

1. Preliminary Considerations

The idea of hastening the passage of ureteric stones by some form of probe or by the injection of liquid is as old as cystoscopy itself. A number of ingenious instruments have been described for this purpose, but they are not enumerated here since the majority are now only of historical interest. The decisive contribution was made by ZEISS (1939) who described the use of his loop catheter in encircling and extracting ureteric calculi. Most metal stone extractors are based on a different principal, e.g., BÖHRINGER's dilator and extractor, the Johnson basket, so popular in America, and more recently the DORMIA basket.

I myself have only limited experience with any of these instruments and am not therefore competent to give a comparative evaluation. I confine myself in the following to a more detailed description of what I know from my own practice.

All stone extractors have in common that force should never be employed if the number of injuries is to stand in an acceptable ratio to the benefits.

Correct appreciation of the indications and good endoscopic technique may combine to spare a large number of patients open surgical ureterolithotomy.

This manual selects the Zeiss loop for detailed discussion, because its action is the most physiological, brilliantly exploiting ureteric peristalsis to facilitate passage of the stone per vias naturales. In the USA the Zeiss loop is generally known as the 'Ellik loop' since the latter published his experience with a modified Zeiss loop in 1947. It is a matter of medical historical justice to call the instrument by the name of the man who first had this brilliant inspiration and published it.

The term 'extraction' unfortunately still abounds in many books, although it may from time to time persuade endoscopic surgeons to tug harshly on the stone. Such misplaced maneuvers would be best avoided by the term being banned altogether.

2. Indications for Using the Zeiss Loop

Use of the loop is ideal for small calculi showing little or no tendency to pass despite mild obstruction and several episodes of colic. A smooth concretion not impacted in the ureteric wall by any sharp or barbed crystals may almost certainly be helped on its way with this instrument. Because of the greater distance to be overcome, calculi in the upper third of the ureter are less suitable for this technique than those in the middle or lower thirds.

Special indications occasionally recommended, such as the extraction of calculi from the renal calyces or pelvis, are not discussed here. Any calculus leading to marked obstruction or pyonephrosis is an absolute contraindication to use of the loop, since these should always be removed surgically without further delay. The calculus in an only kidney is a much debated indication, as sepsis following use of the loop might expose the patient to grave risks.

Unfortunately there is no simple and generally valid set of indications – personal experience will play a major role. The above remarks should therefore only be looked on as general guidelines rather than a rigid norm.

3. Description of the Zeiss Loop

Any understanding of the mode of action of the Zeiss loop will require some knowledge of its design (Fig. 221).

The loop consists basically of a specially modified ureteric catheter. A nylon filament attached to the tip enters the lumen through a side hole and protrudes through the lower end. Traction on this filament forms the catheter into a loop. Placing the aperture at various levels alters the size of loop. The diameter of the loop, corresponding to approximately half the distance from tip to side hole, should suit the size of calculus to be removed. Small calculi require small loops and larger calculi large ones.

To prevent its kinking into an acute angle, the point of curvature of the loop is mechanically reinforced so as to maintain a smooth contour.

Loops are available from a variety of manufacturers and may consist either of plastic or of coated silk fabric.

In addition to his plain loop, Zeiss also described a so-called tilting loop (Fig. 222). A second filament enables the loop, once formed within the ureter, to be tilted on its side. This allows calculi to be caught in the loop that would

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Fig. 222a–c. The tilting loop. This loop allows calculi to be grasped which the standard loop would ▷ usually slide past. It has a twin mechanism under the control of different colored filaments permitting its various movements to be induced from without, even when it is invisible. This is of particular importance where an image intensifier is not available. **a** Appearance of the uncoiled loop. The two filaments are easily seen. The upper one re-enters the catheter at approximately the point where the lower one emerges. **b** The upper loop proper is closed, **c** and traction on the second filament then tilts it within the ureter to suit the precise configuration of the calculus

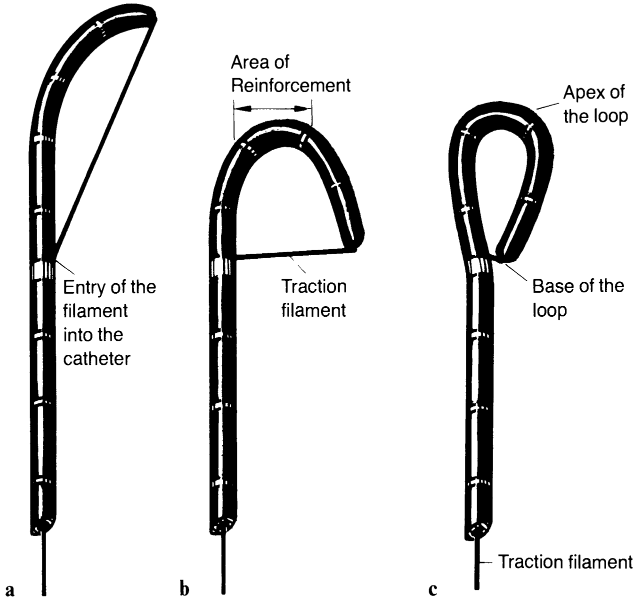
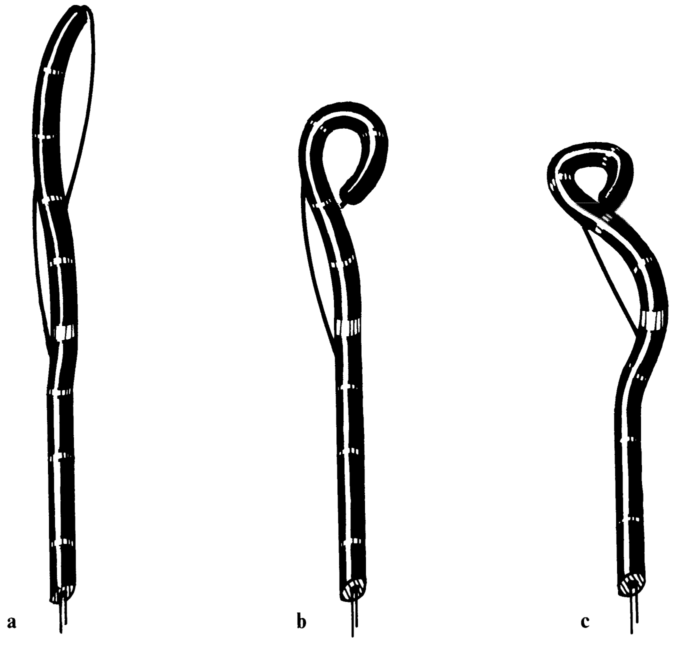

Area of Reinforcement
Apex of the loop
Entry of the filament into the catheter
Traction filament
Base of the loop
Traction filament
a
b
c

Fig. 221 a–c. Three steps in coiling the Zeiss loop. a Gentle traction on the filament initiates curvature of the loop. As this progresses the filament is drawn out as a bowstring, being attached to the tip of the catheter and entering it through a side hole. This entry point subsequently becomes the base of the loop. **b** Curvature of the loop is now well advanced. The midpoint of the loop has a built-in reinforcement to prevent kinking of the loop within the ureteric lumen. **c** Completely closed loop



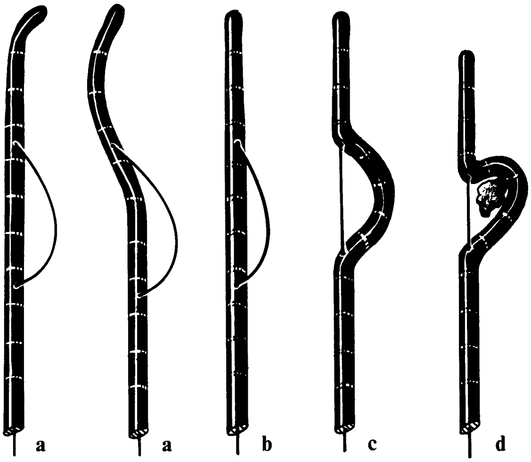


Fig. 223a–d. Davis loop. This loop differs from the original Zeiss loop by the attachment of the cord some centimeters away from the tip of the catheter, its re-entry point being correspondingly lower. The advantage is that the catheter tip may be made finer and may have a preformed curvature to encourage it pass the stone. Its disadvantage is the poor shape of the loop which cannot be completely closed. This type of catheter is seldom used in Europe. **a** Alternative catheter tips. **b** Uncoiled catheter. **c** Early loop formation. **d** Completely closed loop

otherwise remain in local dilatations of the ureter. Zeiss originally intended this loop for long, pointed calculi which the standard loop might otherwise slide past.

A variety of loops were subsequently described in which the folding segment followed on a nose piece of several centimeters length (Fig. 223). The latter may be conical, slightly curved or spiral. These variations occasionally facilitate advancing the catheter past the stone. Unfortunately they do not fold into such a smooth outline as the original Zeiss loop.

No further mention is made of the various derivatives of the Zeiss loop, since they offer no substantial advantage over the original type.

4. Introducing the Zeiss Loop

a) The Standard Loop

In typical cases the Zeiss loop is easily passed (Fig. 224). The catheter is passed into the ureteric orifice in its straight configuration and then advanced past the calculus, often noticeable only as a slight resistance, to be closed into a loop above the stone. A metal cone on the external end of the catheter prevents the nylon filament from slipping back and allowing the loop to open in the ureter. Where the stone lies particularly low the external end of the loop may

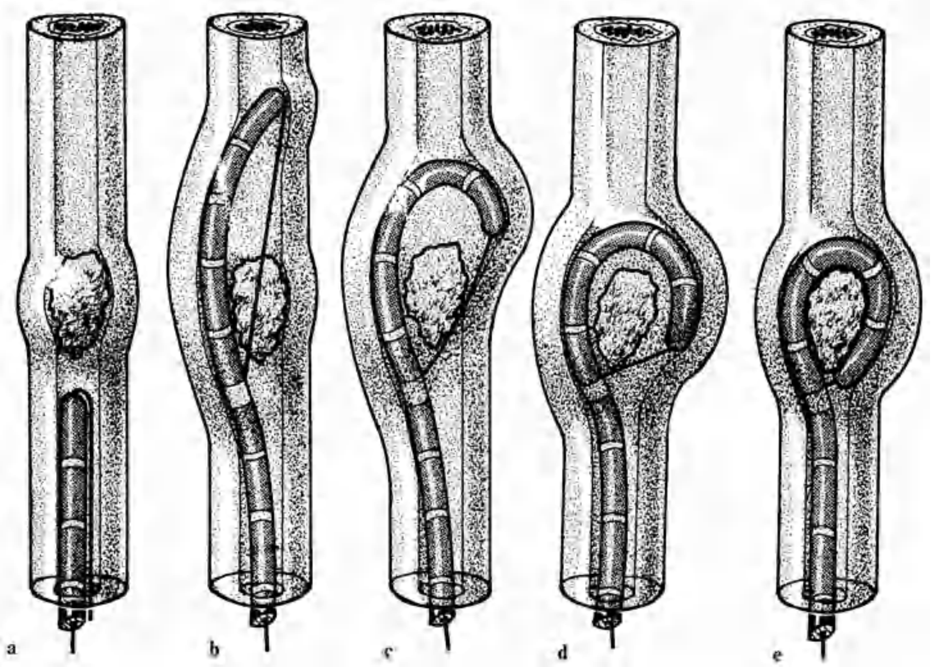


Fig. 224a–e. Coiling the Zeiss loop within a ureter. a The catheter approaches the calculus. **b** The tip of the loop has passed beyond the calculus into the upper ureter. Gentle traction on the cord bends the catheter into a curve. **c** Early loop formation. During this process the curvature of the catheter somewhat stretches the ureter. **d** The loop is almost closed and encircles the calculus. **e** Completely closed loop. Note: The size of the loop must suit that of the calculus. An ideal fit is shown here

be coiled up and fixed in the shape of a ring by adhesive tape, thus preventing the patient from himself tearing or pulling out the whole length of the loop by an inadvertent movement.

Optical control by image intensifier screening greatly facilitates the process of loop placement. Closure of the loop around the stone may then be directly observed. We generally prefer to coil up the loop in the renal pelvis and retract it under video control until it reaches the calculus within the ureter. The great advantage of this procedure is the availability of enough space so as to render virtually impossible accidental injury to the ureter during coiling of the loop (Fig. 225).

In rare cases it may be impossible to advance the catheter past the stone. The best procedure is then to first pass a 5-Ch ureteric catheter with a curved tip past the calculus and make a renewed attempt to pass the Zeiss loop alongside this seeker. Occasionally even this method fails to allow the loop past the calculus. One or two days should then be allowed to elapse before a further attempt is made. If this is again unsuccessful ureterolithotomy should be considered as a simpler alternative.

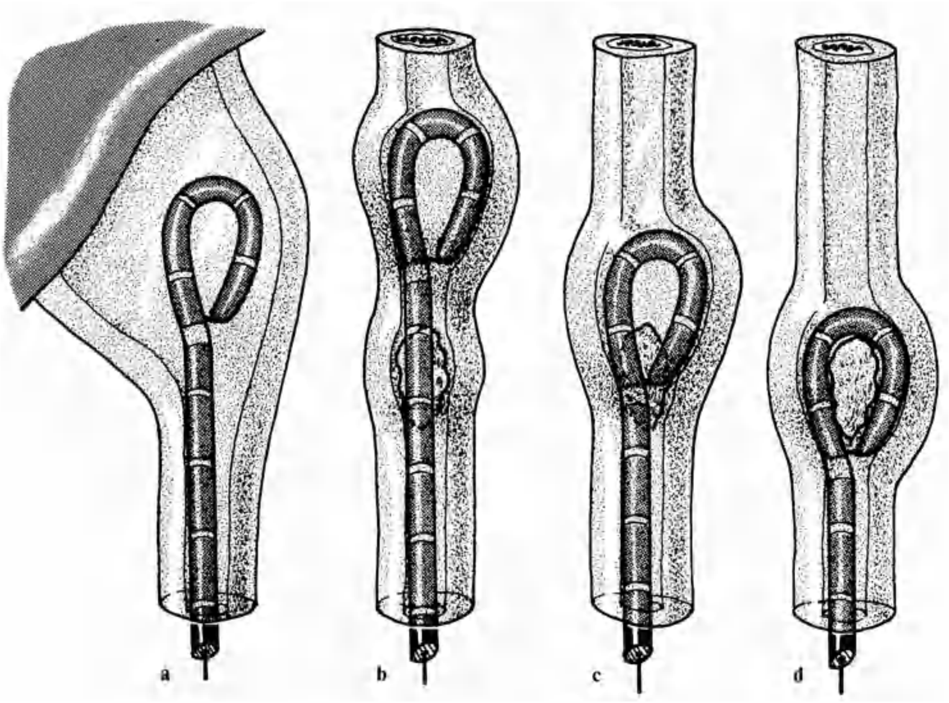
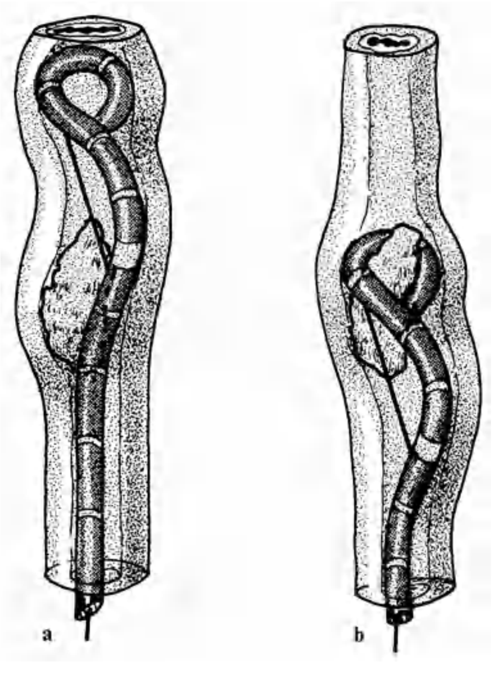


Fig. 225a–d. Coiling the Zeiss loop in the renal pelvis. **a** The loop is most easily formed within the renal pelvis, because of the available space. **b** Once closed, the loop is withdrawn down the ureter. **c** Loop approaching the stone from above. Further traction may be discontinued at this point since the loop then usually advances over the stone of its own accord. **d** Snug fit of loop and calculus



b) The Tilting Loop

This variation on the basic pattern which dates back to ZEISS himself may be employed whenever a normal type of loop cannot be brought into contact with the calculus. Such a state of affairs is easily verified on the image intensifier.

If one or more attempts to engage a normal loop around the calculus are found to fail by the latter sliding past the calculus rather than capturing it, it may be indicated to make an attempt with a tilting loop.

'Slim' pointed calculi are frequently the ones whose shape allows normal loops to slip past. Such calculi are more easily grasped in a tilting loop.

Once again the loop is coiled up above the calculus and retracted into its immediate proximity. Traction on the second nylon wire then initiates tilting of the loop. Further retracting the loop and if necessary increasing its angle of tilt may allow the calculus to be grasped so that its point passes into the aperture of the loop (Fig. 226).

The remainder of the procedure is the same for tilting and standard loops. An indwelling loop or the traction technique may be employed.

c) Checking Loop Position

For most cases a simple radiograph is adequate, tomograms only being required where the calculus is shielded by bone. This latter problem is particularly likely to arise in relation to smaller calculi within the bony pelvis, where the bone may be so dense as to permit demonstration of the loop but not of the calculus on plain radiograms. Cuts at 11–13 cm will provide a good image. Such additional radiology is not usually needed where the calculus lies opposite a transverse process. Superimposition of intestinal gas or feces may also necessitate tomograms.

We only take pictures at the beginning of treatment to ensure that the loop is properly closed and the calculus engaged within it. Further progress of the procedure may be simply monitored by the catheter markings appearing at the external meatus. It may be psychologically beneficial to entrust the task of documenting this to the patient himself, so that he can follow the progress of his treatment. Loop progress should be recorded on the observation chart.

5. Techniques of Calculus Extraction

Once the calculus is well engaged in the loop, a fact easily demonstrated on plain X-ray, somewhat less so on screening, there are two basic methods for extracting loop and calculus.

◁ **Fig. 226a, b. Use of the tilting loop.** **a** The loop is precoiled in the ureter above the calculus. The second filament has been used to achieve a slightly tilted position. **b** Careful traction (best performed under image intensification) brings the loop into contact with the calculus. Difficult cases may require adjustment of the angle of tilt, depending on the situation

a) Traction Technique

The original idea behind this technique was that it would permit removal of the stone by more or less forceful traction on the loop. Apart from the slight advantage of rapid removal this method harbors a number of disadvantages:

1. The loop may slip off the stone. Besides representing an additional burden on the patient, further attempts at introducing the catheter may not succeed in passing the stone.
2. Calculus and loop may become so impacted in the ureter as to be irremoval except by a degree of brute force posing an unacceptable risk of injury.
3. Ureteric injuries may occur.

We only employ this technique in the final stages, i.e., when the base of the loop is already visible at the ureteric orifice. In these circumstances calculus and instrument lie in the intramural portion of the ureter which is well buttressed by robust bladder muscle. After a few days a lubricant layer of fibrin and leucocytes will anyway have formed at this level so as to greatly facilitate final extraction. It should not then be necessary to traverse a distance of more than 2–3 cm by traction.

b) The Indwelling Loop

This form of treatment makes ideal use of normal ureteric peristalsis and thus facilitates stone extraction by physiological means.

As shown in Fig. 227, a space opens up between loop, calculus and ureteric wall through which urine is able to drain. The truth of this may be seen in the reduction of ureteric dilatation which usually follows on placement of a Zeiss loop. This free or only moderately obstructed drainage of urine combines

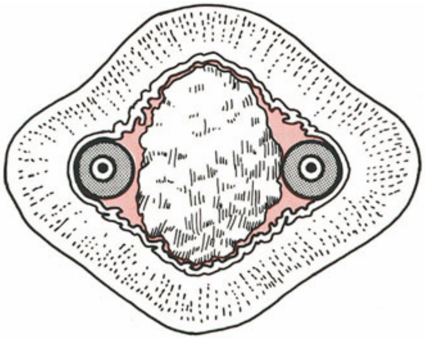


Fig. 227. Diagrammatic cross section through a ureter containing a calculus and encircling loop. The Zeiss loop passing around the calculus opens up a number of clefts through which urine is able to leak past the stone down into the bladder. Normal peristalsis may thus continue, being finally responsible for onward transport of calculus and loop

with increased diuresis to permit the passage of peristaltic waves down the ureter, whilst the inferior taper of the loop progressively dilates the ureter, permitting its advancement. If the loop fails to descend spontaneously, its progress may be accelerated by attaching a small weight, usually under 50 g and maximally 100 g.

A properly placed loop virtually never gives rise to pain or other symptoms requiring analgesic medication. Patients should be encouraged to drink and not be allowed to remain in bed. In selected cases a loop may be inserted by the specialist in his consulting rooms and the patient is then seen once daily on an ambulant basis to check its position.

6. Hazards

Properly employed the Zeiss loop is an entirely safe instrument, and only in the rarest of cases have we come across injuries resulting from its use. Attempts to advance the catheter past a long arrested calculus might result in the ureteric wall giving way at a point of advanced inflammatory change, with consequent perforation. I am personally aware of a single case in which perforation of the renal pelvis was noted some days after a loop had been coiled within it. Although this event subsequently resulted in legal proceedings its cause was never established with any certainty.

Urinary infection is a further source of complication. Strictest asepsis should therefore be observed during catheterization, which should always be proceeded by urine culture. There are no reliable figures on the benefit of prophylactic antibacterial therapy.

Despite the low complication rate, the procedure should always be carefully discussed with the patient prior to carrying it out, and his attention should be drawn to the dangers of perforation and infection.

Loops which come to rest at the site of previous chronic inflammatory change or of scars due to previous ureteric or adjacent surgery may be unable to proceed further. They should then be removed surgically along with the calculus at ureterotomy. On rare occasions I have experienced separation of the loop at the point of entry of the nylon filament. The procedure may usually nevertheless be brought to a satisfactory conclusion because further traction on the nylon is still able to draw both loop and calculus down towards the bladder. There is a theoretical risk of forceful traction rupturing the ureter, a disastrous complication of which I know only by hearsay.

Impaction of the loop in the ureteric orifice. Very occasionally the ureteric orifice may be so oedematous as to prevent passage of loop or calculus. Although repeatedly recommended, incision of the ureteric orifice may give rise to vesicoureteric incompetence and reflux. Local intramural injection of hyaluronidase is an excellent alternative and softens the tissues in the same way as when used for the reduction of paraphimosis.

II. Placement of Indwelling Ureteric Catheters

1. Passing Plain Catheters

This purpose is best achieved by ureteric catheters of 6- to 8-Ch caliber upwards. The previously popular soft rubber catheter of PFLAUMER, which required a special introducer, has now fallen into disuse. We always specially prepare our own ureteric catheters by nibbling out additional holes near the tip with a small Luer forceps. These holes are placed over a distance of 4–6 cm, depending on the exact purpose (Fig. 228).

After punching out the holes it is necessary to briefly immerse the catheter in boiling water so as to separate the crushed edges of the walls. The catheter is then packed in the routine fashion and resterilized by ethylene oxide.

The passage of such catheters occasionally requires one or more of the special maneuvers described below.

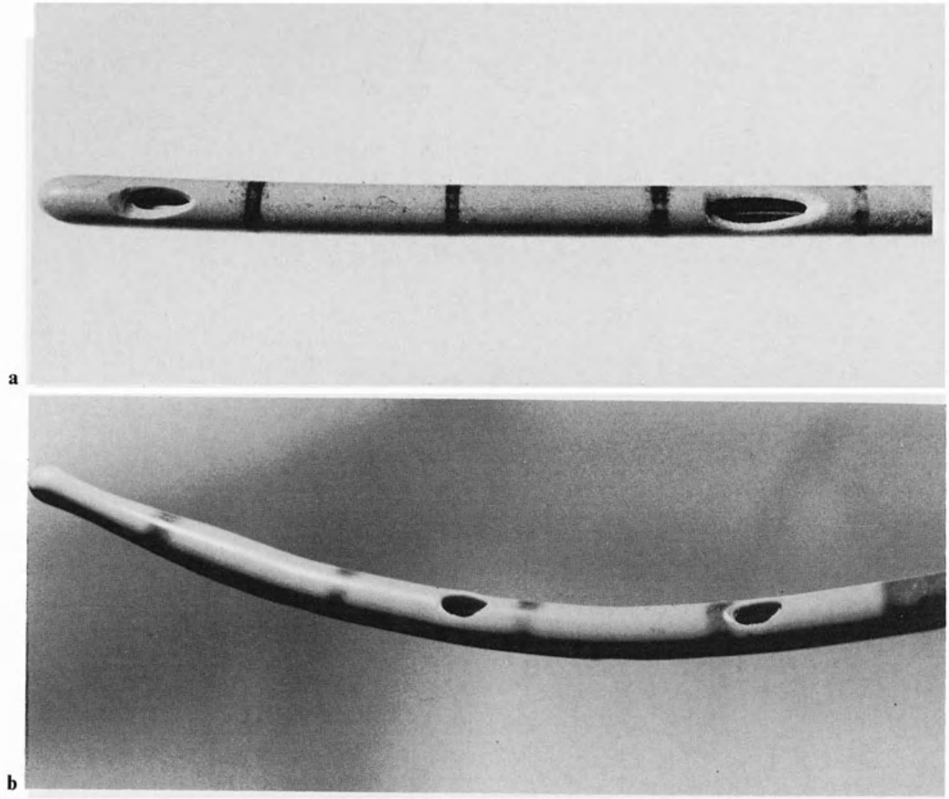


Fig. 228a, b. Plastic ureteric catheter (8-Ch). a A straight catheter showing additional holes punched out with Luer forceps in a 'customized' arrangment prior to catheterization. **b** Curved ureteric catheter. Sterile gloves were used to immerse the catheter in boiling water and subsequently hold it in the required configuration. Customized curvature can thus be achieved

It is frequently advisable to bend the tip of the catheter to suit curvatures of the ureter identified on previous retrograde ureterogram or on IVU. The catheter may be simply immersed in boiling water and subsequently held in the desired configuration by means of a sterile glove until it has cooled off again. Any catheter may thus be adjusted to its particular purpose.

Wherever possible, metal stylets should be avoided since they tend to make the catheter too rigid to follow the normal course of the ureter.

Axial rotation of the catheter during instrumentation frequently facilitates its introduction. Occasionally it is helpful to inject small quantities of contrast medium under image intensifier control. Cues then become available for further manipulation.

Head-down tilt helps to correct curvatures in the ureter. The introduction of large (e.g. 8-Ch) catheters is sometimes facilitated by previous passage of one or two smaller catheters (5 or 6-Ch), which are then withdrawn pari passu as the large caliber catheter is advanced.

Catheters are best held in place by fixing them to a small balloon bladder catheter passed alongside them.

2. Indwelling Ureteric Catheters

Catheters have recently become available which enable continuous drainage of urine over long periods of time. The first practicable instrument for this purpose was the Gibbons catheter (Gibbons et al. 1976), but the sharp barbs designed to retain it within the ureter frequently render its retrograde removal through the bladder extremely difficult. For this reason we have ceased using it.

The technical problems of indwelling ureteric catheterization have been largely solved by the introduction of double-J catheters. We have considerable experience with this type of indwelling catheter over a long period of time and for this reason it alone is described in further detail.

3. Indications for Indwelling Ureteric Catheterization

A variety of syndromes may demand permanent ureteric drainage.

One of the most frequent indications in our practice is unilateral or bilateral ureteric obstruction by urate stones, which can be dissolved chemically under antibiotic cover in the presence of an indwelling catheter.

Second in frequency are stitch line dehiscences following pyelo- or ureterolithotomy. This group of indications also includes prophylactic drainage in relation to such surgical procedures.

Finally we also use this type of urine diversion in cases of partial or complete occlusion or compression of the ureter by infiltrating tumors. The majority of these are gynecological or rectal carcinomas.

4. The Double-J Catheter and Its Properties

The catheter is composed of radiopaque silicone elastomer (Fig. 229). This material has a minimal tendency to become encrusted and may be left in the renal pelvis, ureter and bladder for several weeks, at least six in our experience, without fear of encrustation. Both ends of the catheter are curved into a three-quarter circle. A metal introducer holds the catheter straight during placement.

Catheters are available packed as sterile sets comprising four lengths from 16–30 cm and two calibers, 7 and 8.5 Ch. These are quite expensive and their use is therefore only justified for cases requiring prolonged treatment.

a) Technique of Catheterization

The catheter is first straightened by introducing the stylet. Catheterization is then no more difficult than with ordinary ureteric catheters. Once in the renal pelvis, the tip of the catheter is allowed to assume its intrinsic curvature by withdrawal of the guide wire.

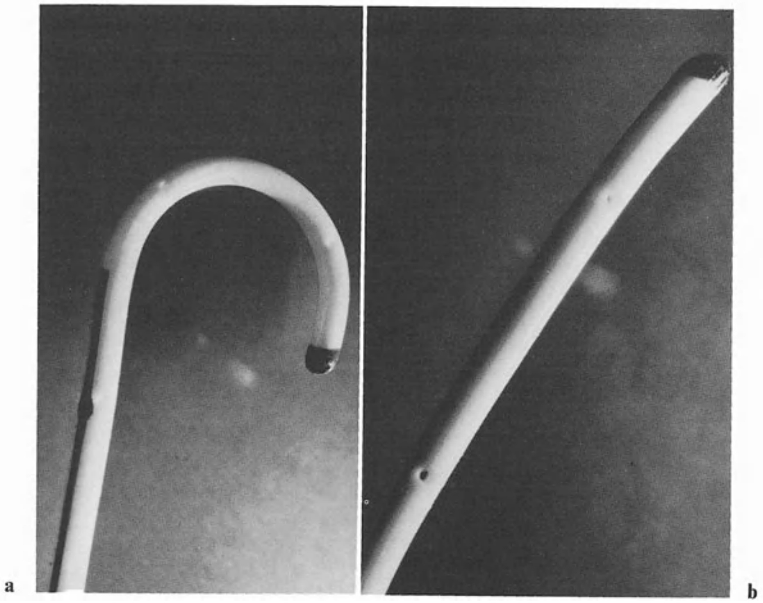


Fig. 229a, b. Double-J catheter. View of one end of the catheter. Both ends are bent into a three-quarter circle. They return to this curvature whenever the introducing wire is withdrawn. **a** Catheter in curved configuration. Curvatures within the renal pelvis and bladder secure the catheter in position. **b** Catheter straightened out

b) Difficulties During Catheterization

Whatever the etiology, any case of ureteric obstruction may require prior passage of a fine (4 or 5-Ch) catheter as a dilator. Under some circumstances it may be necessary to pass a further ureteric catheter alongside the first, and this may be delayed for several days if the flow through the first one is adequate. Removal of the fine 'dilating catheter' should be followed as soon as possible by passage of the double-J catheter, the one ideally being withdrawn as the other is advanced.

5. Side Effects

All patients suffer vesicoureteric reflux. Calculus patients suffer no ill effects because the short period of catheterization, and in carcinoma cases the underlying disease itself, determines the outcome.

As with any ureteric catheter, infection may be a significant factor. Clinical infection should be kept under control by additional antibiotic therapy, but the presence of the catheter as a foreign body will always prevent its complete eradication.

During short periods of catheterization encrustation is unlikely to become a problem, since several weeks are usually required for anything to accumulate on silicone material. Where the indication is chemical dissolution of obstructing urate stones or the drainage of postoperative leaks in the renal pelvis or ureter, the period of catheterization is likely to be so brief as to prevent this complication occurring.

Chapter L

Endoscopic Procedures in the Urethra

By R. Hartung

I. Introduction

Operative procedures in the urethra have been carried out blind since the mid-nineteenth century. Bouginage as a conservative treatment of urethral strictures was undertaken long before.

The introduction of urethrotomy marks the beginning of true urethral surgery, since bouginage of strictures is not strictly speaking an operative procedure. In 1854 Maissonneuve presented the urethrotome which bears his name (see Helmstein 1964) and in 1872 Otis described a different instrument which was adjustable in caliber. Both instruments are still in use with only minor modifications to the original design over 100 years later. Only in this century has it become possible to carry out urethral operations, such as the incision of strictures, under direct vision. In recent years a few authors have described use of the laser beam as a transurethral technique for the correction of strictures.

Stricture surgery represents the bulk of all urethral endoscopic procedures, and the excision of urethral tumors is by comparison an extremely rare indication for endoscopy. Coagulating probes or a laser beam may be used for the destruction of such tumors where the danger of surrounding tissue damage precludes the use of a resectoscope loop.

In most cases the bladder will also be affected and radical cystourethrectomy should be preferred to transurethral treatment.

On the other hand a bladder neck stricture following transurethral or suprapubic prostatectomy is easily amenable to treatment with the viewing urethrotome or with the resectoscope.

A recent addition to the repertoire of endoscopic urethral surgery is submucous infiltration of the bladder neck with teflon in an attempt to relieve various types of urinary incontinence, chiefly stress incontinence in women and iatrogenic incontinence following prostatectomy in men.

II. Internal Urethrotomy Under Direct Vision

1. History of the Procedure

Fischer described the notching of short urethral strictures under direct vision in 1937. In his technique a wire hook was used as an electrical cutting instrument. Ravasini (1957) and Elsässer and Schmiedt (1970) have subsequently described a similar approach. It was the high recurrence rate following electrosurgical treatment of such strictures that led to the idea of cold incision using a sharp knife under direct vision. In Germany Sachse (1964, 1978) and Matouschek and Michaelis (1975) and various others have repeatedly published reports on this technique. Sachse in particular has made great efforts to standardize and improve the technique of operation as well as developing special instruments. The outcome of this has been the viewing urethrotome that bears his name. Similar instruments designed to work in a comparable way are associated in Germany with the names of Sökeland and Dettmar.

2. Diagnosis of Urethral Stricture in the Male

Typical symptoms will direct attention towards the possibility of stricture, and a diagnosis may be confirmed by cystourethrogram or by urethroscopy. Uroflowmetry will reveal a typical plateau flow curve, confirming the symptomatology (Fig. 230).

3. Indications for Urethrotomy Under Vision

The indications for any corrective treatment of a urethral stricture must be seen in relation to the severity of the patient's symptoms, urine reports (bacteriology and microscopy) and the extent of the stricture (result of cystourethrogram, micturating cystogram, uroflowmetry and endoscopy). Any decision on the relative merits of plastic correction or viewing urethrotomy must equally be related to the extent of the stricture, the patient's age and whether the stricture is primary or recurrent.

The chief advantages of viewing urethrotomy are that it is a minor procedure allowing precise incisions to be made around the stricture under direct vision. The procedure is repeatable and may be carried out under local, regional or general anesthetic.

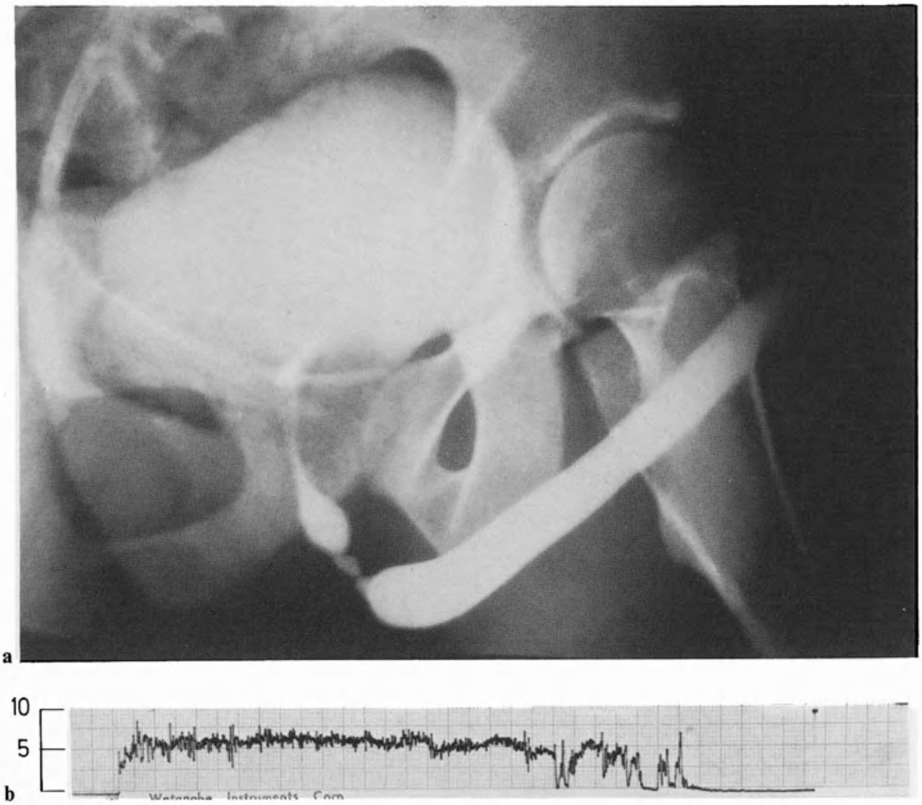


Fig. 230. **a** Cystourethrogram demonstrating a stricture of the bulbar urethra. **b** Typical plateau urine flow curve. Volume 300 ml, maximum flow rate 6 ml/s, micturition time: 40 s

4. Undertaking Surgery

a) Instruments

A viewing urethrotome does not greatly differ from a resectoscope, consisting as it does of a 20-Ch urethrotome sheath and obturator and of an operating element, which bears the knife and also has a channel for the passage of sounds. A 0° telescope is generally used.

The standard knife used in the instrument of SACHSE has a cutting edge around its blunt tip and along the upper margin, allowing it to cut both forwards and upwards. Alternative blades with a circular or undulating profile are also available. A special channel is provided to accept ureteric catheters.

The optical urethrotome as modified by DETTMAR has the knife attached at something of an angle away from the 12 o'clock position, thus permitting a free view of stricture and scalpel blade at the same time. Furthermore this instrument allows a guide catheter to be passed through a small loop on the knife itself, so guaranteeing that the knife is guided along the catheter.

The sheath of either instrument will accept a further sleeve around their exterior. This is intended to facilitate the subsequent passage of balloon catheters, the external sleeve being left in the urethra when the urethrotome is withdrawn.

The SÖKELAND instrument also has the curved scalpel blade set at something of an angle.

Like all endoscopic instruments, the urethrotome requires a fiberoptic light cable, a light source and suitable inlet and drainage hoses for irrigation. REUTER (1980) has exploited the continuous irrigation principal of IGLESIAS to design an irrigating urethrotome.

Instruments of 10-Ch diameter are available for dealing with paediatric problems.

b) Preoperative Preparation of the Patient

The patient is placed in lithotomy and anesthetized by spinal, epidural or general anesthesia. A number of surgeons also undertake the procedure under local anesthesia after instillation of some suitable locally acting preparation. Sterile drapes are placed in the usual fashion as for any transurethral procedure.

c) Operative Technique

The sheath, closed off by its obturator, is introduced through the external meatus and passed some centimeters into the urethra. The obturator is then removed and replaced by the operating unit. If a more distally placed stenosis prevents passage of the viewing urethrotome, meatotomy must first be carried out as an aid to instrumentation. Under direct vision the urethrotome is now approximated to the stricture. The exact direction of longer strictures is best explored and demonstrated by passage of a suitable leader (5-Ch ureteric catheter). The line of incision then follows this sound. The majority of surgeons recommend restricting incision to the 12 o'clock direction, thus avoiding damage to the corpora cavernosa (Illustration 79, Plate XIV). Incisions at other points around the urethral circumference, e.g., at 8 o'clock and 6 o'clock, may give rise to diverticula and occasionally to fistulation. The incision advances millimeter by millimeter towards the bladder as the scalpel blade is extended out of the sheath and brought into contact with the stricture itself (Illustration 80, Plate XIV). The aim is to achieve a lumen of 24–26 Ch in the region of the stricture. The first hurdle is to get the viewing urethrotome itself with its 20-Ch diameter to pass the stenosis easily.

Minor hemorrhage from the scar tissue may be disregarded, but more vigorous bleeding points may occasionally require treatment with a coagulating probe. Isotonic irrigating solutions should be used, since the irrigation fluid absorbtion syndrome may occasionally occur.

Once the stricture has been so widely opened as to allow easy passage of the urethrotome into the bladder, we generally recommend that the same instrument be used for a brief cystoscopy. In addition to simply incising the stricture some authors recommend infiltrating the surrounding scar tissue with cortisone, some of them before and some after urethrotomy.

d) Operative Difficulties

Where a stricture ends in a number of pinholes, and where the guide catheter cannot be advanced into the bladder through the correct passage, it may be helpful to give indigo carmine, either intravenously or directly into the bladder through a pre-existing suprapubic fistula. Pressure on the bladder will then eject blue dye from the real lumen of the stricture.

Strictures, particularly recurrent ones, are occasionally so ragged that their anatomy is difficult to understand. In such cases it is probably more advisable to discontinue internal urethrotomy and to attempt the passage of a fine catheter into the bladder. Alternatively the bladder may be drained suprapubically, but in either event a way through is then re-explored in a second sitting. On repeated occasions we have first had to leave these cases with an 8- or 10-Ch catheter in situ in the hope that the anatomy will be plainer at a second attempt at urethrotomy.

In cases of complete urethral obliteration by stricture a curved metal sound must first be passed through a suprapubic cystotomy down the bladder neck and into the urethra as far as the point of obliteration. Digital rectal support and gentle movement of the curved sound by an assistant will give rise to movement or bulging in the endoscopic field. The surgeon then slowly cuts towards this point. Particular caution is required in the sphincter region of the membranous urethra (Illustration 81). In this region the stricture should only be incised up to the caliber of the instrument if a sphincter lesion is to be avoided. The indications for viewing urethrotomy in the treatment of complete urethral occlusion should be considered extremely carefully, since open surgical procedures may frequently be more attractive. Urethral stones lying above the stricture may usually be pushed back into the bladder and dealt with there.

e) Operative Complications

Careful technique, irrigation with isotonic solution and strict observance of purulent urethritis or urethral abscesses as a contraindication generally result in a low complication rate. Profuse hemorrhage is usually controlled by the passage of a 24-Ch catheter, occasionally in combination with a penile pressure dressing. Penile or scrotal edema may occur but usually is reabsorbed within 1–2 days. Potency is unimpaired. Ill-advised incision in the 6 o'clock region occasionally gives rise to urethral fistulas.

5. Postoperative Treatment Following Viewing Urethrotomy

Whatever agreement there may be on operative technique, there is none on the best course of postoperative treatment. The following measures are presented for discussion:

1. Passage of a balloon catheter or no postoperative catheterization
2. Instillation of antibiotic and steroid gel
3. Hydraulic self-dilatation
4. Prophylaxis of infection

Like SACHSE (1978) we would recommend that short strictures of less than 5 mm be treated without postoperative catheterization but by the instillation of cortisone gel thrice daily for 14 days. A tape around the penis or a Cunningham clamp is used to retain gel in the urethra. The first dose is instilled on the operating table.

Hydraulic self-dilatation is aimed at dividing urethral adhesions occurring between micturitions. The patient is encouraged to have a liberal fluid intake, resulting in frequent micturition and a good dilating effect.

Strictures over 5 mm long are treated for 3 weeks by catheterization with a 20-Ch silastic catheter, following which they are treated by instillation as described above. Patients being treated for complete stricture need to have a catheter for 6 weeks.

We reserve antibiotic therapy for proven urinary infection. It is not our practice to prescribe antibacterial agents to patients with sterile urine.

III. Endoscopic Laser Surgery to Urethral Strictures

BÜLOW and BÜLOW (1979) have described experimental studies on the ablation of scar tissue around urethral strictures by means of the laser beam. These initial studies using a 'Neodyn-Yag' laser were not followed by any broad clinical application. ROTHAUGE (1979) has reported his more extensive experience using an Argon laser. Operative technique is described as directing the laser beam at the scar tissue, starting at the edge of the stricture. The scar tissue is evaporated with a resulting improvement in the strictured lumen.

Only experience over some time will show whether this technique represents a true alternative to cold internal urethrotomy.

IV. Endoscopic Surgery for Urethral Tumors

1. The Problem

In the presence of extensive papillary tumors or urethral carcinoma, urethrectomy is the only radical approach. Only small, noninvasive papillary tumors of the urethra are suitable for electrosurgical excision. The same may be said of condylomata. Because of the high incidence of cicatrization and stricture formation following the use of high frequency current in the urethra laser coagulation may represent a true advance in this field.

2. Technique of High-Frequency Surgery

A coagulating probe may be used to destroy papillary tumors and condylomata. Larger tumors should be removed with biopsy forceps or by means of the resectoscope loop *without* current. This should be followed by coagulation of the tumor base with the minimum necessary current intensity. Hemostasis may be secured following limited coagulation by passing a 24-Ch catheter.

3. Technique of Laser Coagulation

The laser beam is used to coagulate the tumor, white necrotic tissue is then removed with the biopsy forceps and the tumor base recoagulated with the laser. The same procedure is suitable for urethral condylomata.

Experience in the ablation of urethral tumors and condylomata by laser coagulation is still limited but the risk of subsequent stricture formation appears less than following high frequency diathermy.

V. Endoscopic Correction of Cicatricial Bladder Neck Stenosis

1. Introduction

Cicatricial stenosis of the bladder neck almost exclusively follows transurethral resection of the prostate, only occasionally occurring after retropubic enucleation. The etiology of this syndrome is not entirely clear, although our own work suggests that the majority of patients have had a small 8–15 g prostate resected. In these cases resection was possibly carried too deep around the internal sphincter. There was no correlation with patient age, duration of operation, duration of catheterization or urinary infection. Other workers have found an above average incidence of inflammatory change in resection material.

The resulting bladder neck stenosis may be so pronounced as to virtually occlude the bladder neck, a lumen of only 8–10 Ch remaining. The symptomatology of these patients is frequently enlightening: with the recurrence of a poor stream following previous surgery patients often notice a revival of normal prograde ejaculation.

2. Diagnosis

The diagnosis may be made radiologically by cystourethrogram, yet urethroscopy is preferable. Beyond the verumontanum lies the prostatic cavity, often well cleared of adenoma, ending proximally in a wall of scar tissue. In its center remains a hole too small to be passed by the instrument (Illustration 82).

3. Indications for Surgery

The demonstration of cicatricial bladder neck stenosis too tight to be passed by a diagnostic instrument is in itself usually an unequivocal indication for operative correction.

4. Operative Technique

In previous years it was our rule to treat these cicatricial stenoses by electroresection and subsequent infiltration of the resection zone with steroids. Because only approximately half the patients had a good long-term result we now use the technique of cold incision. Since the etiology of these stenoses may be tissue damage by high-frequency current with a subsequent tendency to cicatrization, a clean, cold incision free of necrotic tissue would seem more likely to result in cure. The recurrence rate following cold incision of cicatricial bladder neck stenosis is considerably lower.

The viewing urethrotome is introduced up to the stenosed bladder neck (Fig. 231) and incisions are made in a stellate pattern, beginning at 12 o'clock, then 9, 3, 6 o'clock (Fig. 232). Even deep incision into this avascular scar tissue results in very little hemorrhage. The scar tissue soon splits apart to leave a considerably wider bladder neck. The point of incision may once again be injected with cortisone, but there is no proof for the effectiveness of this additional therapeutic maneuver. Postoperatively urine is drained by an indwelling catheter for 1–2 days. Antibiotics are only given in the presence of proven infection.

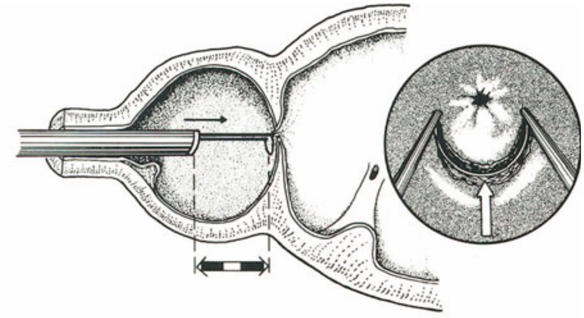


Fig. 231. Diagram showing transurethral resection of cicatricial bladder neck stenosis. The loop being advanced into a full bladder (see also Illustrations 26 and 27, Plate V)

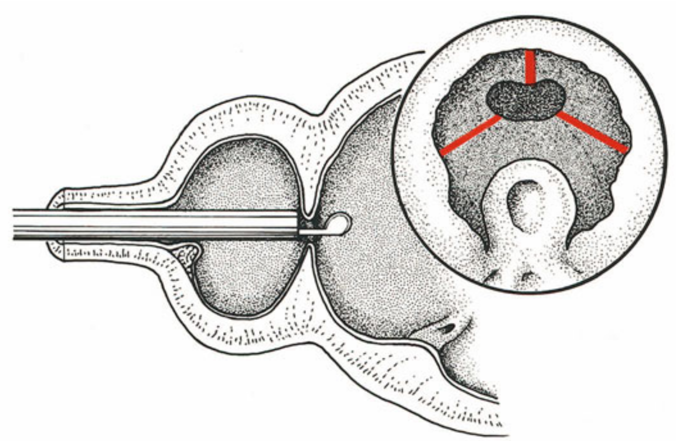


Fig. 232. The principle of viewing urethrotomy for cicatricial bladder neck stenosis. Stellate incisions of the scar plate

VI. Endoscopic Submucous Bladder Neck Infiltration with Teflon in the Treatment of Urinary Incontinence

1. Introduction

The method is based on the principle of narrowing the sphincter region and thus improving bladder control in patients previously incontinent because of inadequate bladder neck closure. Infiltration aims at creating a submucous cushion of nonresorbable material. The principle indications for this procedure are iatrogenic sphincter damage during TUR of the prostate or during retropubic enucleation, on the one hand, and certain types of stress incontinence in the female on the other. Lampante et al. (1979) and Heer (1977) have described both operative technique and results. The former author also describes a special instrument of his own design.

2. Operative Technique in the Male

The following procedure is recommended, whatever instrument is employed: deposits of teflon paste are injected through a cannula at the level of the upper bladder neck, around the prostatic apex and around the sphincter, the aim being to constrict the urethral lumen at all these sites. Four to six deposits should be placed around the entire circumference, leaving a 'starfish' configuration of the lumen. At the suspected level of the sphincter a particularly large deposit should be placed in the 12 o'clock position, since this is frequently the site of the lesion, and this 'gap' is then closed. Catheterization is initially omitted, postoperative retention being treated by the passage of a thin (14-Ch) catheter. Our own so far somewhat limited experience of this technique may be summarized as follows: a definite improvement in continence could be achieved in cases where stimulation of the sphincter region gave rise to some degree of contraction, and where only the 'gap' just mentioned therefore needed to be filled. We had no success with the procedure in cases of rigid, scarred bladder necks, i.e., in patients with an extensive sphincter lesion, in whom fibrotic change of the submucosa made submucous injection difficult or impossible. A number of cases only improved after a second or third repetition of the procedure. Results should not be assessed less than 4–6 weeks following surgery, since initial edema around the operating field often gives rise to transiently somewhat better continence than is achieved in the long term.

3. Operative Technique in the Female

Teflon should be infiltrated in the submucous plane chiefly as close as possible to the bladder neck around its entire circumference. A particularly large deposit should be placed at 6 o'clock, with the aim of achieving a more acute bladder neck angle.

Chapter M

Urethral Dilatation

I. Preliminary Considerations

Despite the great advances in operative treatment, both open and endoscopic, there remains a considerable proportion of strictures needing to be kept open by repeated dilatation. Patients are frequently elderly and refuse more aggressive surgery. Furthermore there are some patients whose stricture may be kept widely open by dilatation at quite infrequent intervals and who therefore have no need of any more active treatment.

II. Bougies and Dilators

Dilators may be rigid or flexible. Rigid metal dilators are available in a curved or straight pattern. Flexible instruments are likewise available with straight or curved tips. The curved tip variety is usually similar in shape to a Tiemann catheter, being hollow and opening near the tip. If necessary, they can therefore be left in the urethra as and indwelling catheter.

III. Patient Assessment

Cystourethrogram is the most important investigation in any patient suspected of a urethral stricture. It is however usually only necessary for initial assessment or for reassessment after a prolonged period of time should a stricture have become so narrow as to make the passage of sounds difficult or impossible. Suitable views will give excellent information on position, caliber and deviation of the stricture.

IV. Dilating the Urethra

There are two fundamental types of dilatation procedure:

Initial dilatation in cases being treated for the first time for a previously undiscovered stricture on the one hand, and dilatation for the maintenance of adequate urethral caliber on the other.

Initial dilatation may be undertaken either blind or under direct vision. First class urethral anesthesia in combination with adequate lubrication is the sine qua non of success.

1. Blind Dilatation

Blind bouginage depends on adequate radiologic demonstration of urethral anatomy. For long, narrow tortuous strictures it is best to use a thin plastic Tiemann catheter (Fig. 233) substituting a curved ureteric catheter of 4 or 5-Ch where the smallest Tiemann catheter (6 Ch) will not pass. Gentle rotation of the curved tip generally allows the stricture to be entered. A great deal of patience, *but no force* should now be employed to pass the bougie up into the bladder.

Sometimes it helps to pass the catheter down the central bore of a straight metal bougie of MAY pattern (Fig. 234), since this may make it easier to direct the tip of the bougie into the inlet of the stricture. High viscosity lubricating agents may also be injected down the straight bougie into the direct proximity of the stricture.

The passage of this first bougie has both therapeutic and diagnostic importance, and the individual twists and turns of the stricture should be carefully noted so they can be imitated when passing the next size of dilator.

On occasion it will be clear from the great hardness and rigidity of the stricture that the next bougie will be impossible to pass. In such cases no attempt at further dilatation should be made. The last bougie should be firmly secured

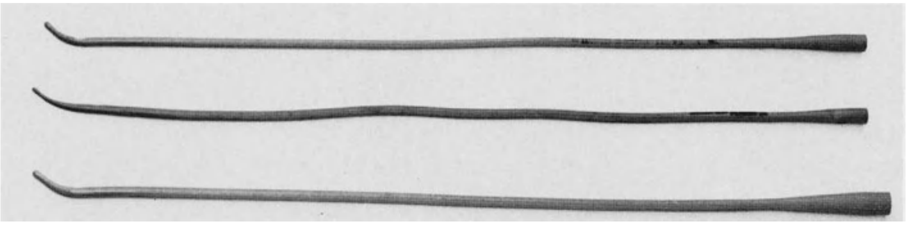


Fig. 233. Plastic Tiemann dilators. This bougie has a great advantage over rubber Tiemann catheters in the extreme surface smoothness of the plastic material. The tip of the instrument may be twisted so as better to enter a stricture. A further advantage over rigid dilators is their suitability to be left in situ for several days as an indwelling catheter and dilator

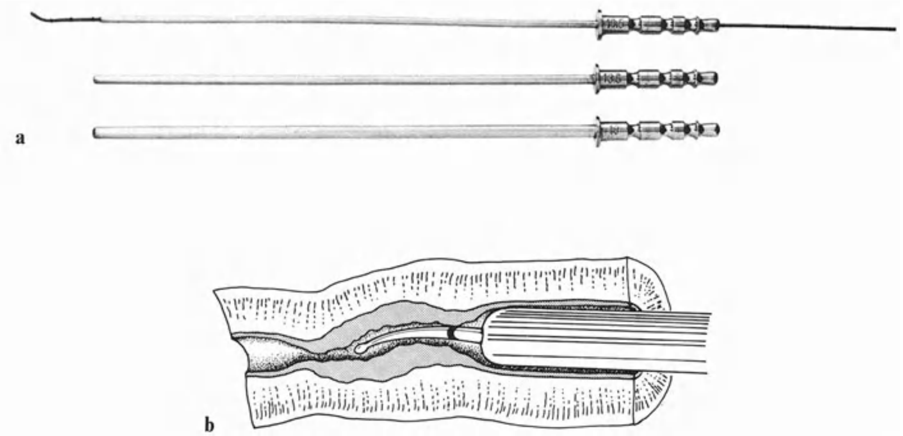


Fig. 234a, b. Diagram showing stricture dilatation with a May bougie. a May bougies of various caliber. The central bore of the bougie allows a ureteric catheter to be passed and guided by the instrument. The central bore is also useful for the injection of lubricating agents around and into the stricture. Twisting the tip of a curved ureteric catheter enables it to follow the tortuosity of the stricture. **b** The straight bougie is brought up against the stricture. Some lubricant is then injected into the urethra and through the stricture. This provides for initial dilatation of the narrow pathway and coats it in lubricant. By twisting and shifting the orifice of the metal bougie the ureteric catheter will eventually find its way into the stricture. A curved tip, 5-Ch ureteric catheter is most suitable

(even if only a 4- or 5-Ch ureteric catheter) and a further attempt made the following day. One or two days later there is usually little difficulty. This progressive dilatation of urethral strictures almost certainly avoids any trauma in the shape of mucosal tears. Hence an 8- or 10-Ch catheter can be passed through the stricture into the bladder. There will be no obstacle to further urethral dilatation by a daily change of indwelling catheter progressing upwards in 2-Ch steps.

2. Dilatation Under Direct Vision

a) Preliminary Considerations

This technique requires an efficient urethroscope. It was FISCHER in 1937 who first employed the urethroscope named after him for the passage of sounds through urethral strictures. No further mention is made here of his electrosurgical incision of strictures, since this was already done in the section on viewing urethrotomy. We are concerned here only with his method of sounding urethral strictures and with their subsequent dilatation with the bougies described by DÜTTMANN (1938). Only little space is devoted to this description, since the method is to some extent superseded by the SACHSE technique of viewing urethrotomy.

The technique has furthermore been modified by the introduction of straight bougies by May in 1949, and we now also have considerably more effective urethroscopes at our disposable. There has nevertheless been little change in the basic technique.

b) Technique

The stricture is brought into view with the urethroscope and with irrigation on. A 5-Ch ureteric catheter with a curved tip is then introduced down the operating channel. Irrigation is maintained (!) and the catheter advanced, if necessary with a twisting motion, until it reaches the bladder. Entry into the bladder is denoted by urine dripping from the end of the ureteric catheter.

For safety the catheter is then advanced a little further into the bladder and the endoscope withdrawn off it. Next a May or Düttmann bougie is passed over the catheter and up to the stricture.

I personally prefer May's bougie because the absence of any curvature makes it easier to maneuver within the urethra. A No. 7 bougie should be selected first for very narrow strictures. The left hand holds the tip of the bougie and tests the guide catheter from time to time for freedom of movement, as well as tensing it and withdrawing it slightly, whilst the right hand extends the penis and slides the bougie through the stricture. As long as the rule of only advancing the metal tube over a freely mobile guide catheter is observed, accidental injury is impossible. Once the metal bougie has entered the bladder, it should be left there for a period of time so as to enhance its dilating effect. The guide catheter is then passed as far as possible into the bladder and the metal bougie removed. The next size of metal dilator is passed over the guide catheter in the same way. There is usually little difficulty at this stage.

The technique requires a certain amount of practice, ever more difficult to gain in the era of viewing urethrotomy. Even since Sachse's recent description of his technique I have repeatedly had cause to employ the above method, always successfully and not infrequently in acute emergencies.

Once a bougie of 20 Ch has been reached, further lubricant is injected around the guide catheter (which remains in the bladder), and an open-ended catheter passed up the urethra. This should be 2 Ch *smaller* then the previous metal bougie, thus avoiding difficulties in its passage. It is then secured as an indwelling catheter. The rest of the procedure follows that for progressive dilatation by indwelling catheter.

This method should no longer be used routinely, since it gives rise to considerable urethral tears which may themselves cause further strictures in the future. If the urethra is inspected immediately after the passage May's bougies a number of deep tears will always be seen. The technique is highly traumatic and the indications for its use are therefore limited to emergency situations.

3. Repeated Dilatation as Definitive Treatment

As stated at the outset, there will always be a number of patients in whom long-term patency of the urethra may aptly be secured by repeated dilatation.

Rigid metal or flexible plastic dilators are suitable for this treatment and I usually prefer plastic Tiemann catheters, since their surface is exceptionally smooth and their curved tip allows easy entry into laterally placed stricture orifices.

For smooth strictures with no or only insignificant urethral deviation I tend to use a curved metal sound, e.g., of the DITTEL pattern. In particular these are less unpleasant for the patient, since they avoid pronounced downward traction on the penis for the dilatation of strictures around the bulb.

4. Golden Rules of Dilatation

The technique of dilatation must be carefully learned, but is difficult to describe. A few important rules should always be observed:

1. Force should never be employed during dilatation.
2. Dilatation should be undertaken so gently and carefully as to avoid any hemorrhage.
3. Where excessively resistant scar tissue is encountered it is preferable to leave an indwelling catheter for 1 or 2 days than to 'split' the stricture by force.
4. Good anesthesia and lubrication must be guaranteed by the instillation of a suitable combined preparation. At least 5 min should be allowed for this to work.
5. The passage through perineal strictures is occasionally more easily found with the help of external pressure in the perineum.

I should here add two further important rules:

Avoid excessive dilatation. Older textbooks tend to recommend dilating strictures up to 26 or 30 Ch. I consider such a rule to be incorrect and illogical. Such excessive dilatation is bound to give rise to new mucosal tears, themselves enhancing any stricture tendencies. I am quite satisfied to achieve 12–14 Ch and only proceed further in particularly soft and resilient strictures. A urethral caliber of 12 or 14 Ch allows quite adequate micturition.

Dilate as infrequently as possible. Frequent dilatation means frequent urethral trauma. Furthermore it is tiresome for the patient. The correct time for the next treatment is best decided by asking the patient to pay special attention to changes in his stream, and if necessary by suggesting that he make simple measurements with a measuring cylinder and the seconds hand of his watch.

Rationale of this approach. Any treatment of strictures except the operative implantation of a broad epithelial strip is bound to give rise to further scarring and stenosis. The same may no doubt be said of internal urethrotomy, but the hope is then that the *new* scar will be somewhat less tight than was the stricture prior to urethrotomy. If one succeeds in keeping the stricture patent for a substantial period of time, a stable scar may form having little or no noticeable stricture tendency. The patient may thus achieve an acceptable condition, although the esthetic appearance of his cystourethrogram may still be extremely offensive. However, the aim is not internal cosmetic surgery but simply to enable a man to pass urine properly, who feels himself too old for plastic reconstruction and has become fed up with repeated urethrotomy. Dilatation is an excellent alternative in such cases. By the same token it is not a suitable technique for treating strictures in younger patients and certainly not for the initial treatment of any stricture. It is however an acceptable alternative to repeated or unsuccessful urethrotomy. Such cases are unfortunately not all that uncommon, both following surgery in our own clinic and elsewhere.

Whether or not the results of dilating strictures may be improved by long-term instillation of steroid preparations is the subject of a current investigation. No conclusive results have so far emerged.

Chapter N
Postoperative Management

I. Management Following Normal Conclusion of Surgery

1. Passing the Indwelling Catheter

a) Preliminary Considerations

Catheterization brings the operation to its final close. There are as many views on the most suitable type of catheter as there are models of catheter. Any catheter manufacturer can tell a tale of woe on this subject. Individual experience frequently suggests that one particular model is superior, but the wish to hand one's name down to posterity, attached to some special type of catheter, may also play a part. The only important distinction is between balloon and nonballoon catheters.

FOLEY, to whom we owe both the brilliant invention of the balloon catheter and also an unusable resection instrument, originally designed his balloon catheter as a hemostatic device. The vast majority of balloon catheters are nowadays used for reasons of convenience because the balloon retains the catheter without external attachment.

In the absence of any uniform view on catheterization we simply present our own preference with a brief consideration of the indications for individual types of catheter.

b) Catheterization After Satisfactory Hemostasis

In our experience balloon catheters are not necessary in this situation. We use a 24-Ch Tiemann catheter which guarantees good drainage and allows the evacuation of coagula.

Catherization is sometimes rendered difficult by the catheter tip coming to rest against a high internal meatus, i.e., against the highly placed margin of the internal sphincter. This is particularly likely to occur where a chiefly endourethral adenoma had mainly developed towards the rectum. The simple maneuvre of pressing the catheter tip upwards with a finger in the rectum usually solves this problem (Fig. 235). This always needs two people, the surgeon placing the index finger of his left hand in the rectum and advancing the catheter

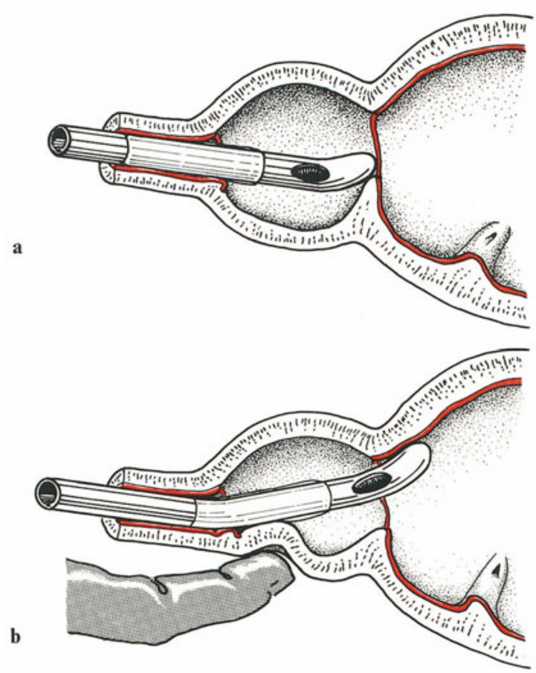


Fig. 235a, b. Catheterization following prostatic resection. a The catheter tip catches on the high posterior fold of the bladder neck and is prevented from entering the bladder. **b** By elevation of the prostatic capsule the catheter tip is lifted and slides into the bladder. Intravesical position of the catheter is confirmed by ease of irrigation. Gas from the bladder vault is usually also evacuated as the bladder completely drains through the catheter. The passage of gas is therefore also a sure sign that the catheter is intravesical

with his right. The assistant straightens and elevates the penis. As the catheter is advanced its entry into the prostatic cavity is ‘anticipated.’ If difficulties persist, pressure may also be exerted on the bulb so as to facilitate entry of the catheter into the prostatic cavity.

Usually only gentle pressure is required to lift the catheter tip over the obstacle. It is extremely rare that a Tiemann catheter cannot be passed into the bladder at all. In these circumstances a Mercier catheter may be helpful. A hollow-tipped catheter on a metal introducer is only necessary in the presence of, e.g., a subtrigonal perforation.

One should not confuse correct placement of the catheter within the bladder with its merely being in the prostatic cavity. Irrigating fluid will still drain but rather more slowly. Above all the characteristic drainage of bladder vault gas (frequently copious following electroresection) will fail to occur. Emptying of the bladder is only followed by the passage of gas when the tip of the catheter is correctly placed in the bladder. This position will also allow easy irrigation and drainage.

The returned irrigating fluid should only be the color of ‘red gravy.’ Fixation of the catheter is easy. As far as I know the method I use dates back to von Lichtenberg’s unit in Berlin.

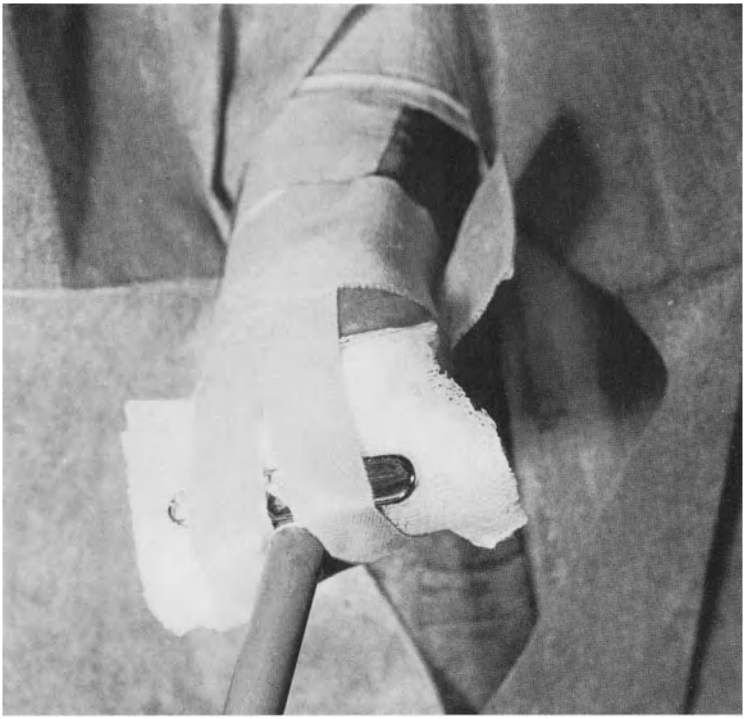


Fig. 236. Securing the indwelling catheter. We frequently use a plain Tiemann catheter without balloon for postoperative drainage. It is secured as follows: the catheter is passed and its position adjusted in the usual way. A stainless steel safety pin is tied to the catheter close to the external meatus. Gauze is placed between glans and pin and a split strip of adhesive tape fixed longitudinally over the pin onto the dorsal and ventral aspects of the penis. This strip is then subsequently fixed by a loose encircling tape, the end of which is folded to facilitate its removal

The catheter is withdrawn until it ceases to touch the posterior wall, where it might otherwise cause bladder spasm. Its correct position is revealed by deterioration of drainage if it is drawn out any further, followed by improvement when it is readvanced. Flow is optimum at the boundary point and the catheter is then well tolerated without giving rise to pain or spasm. Once its position has thus been 'regulated' it is now secured. A length of thread is used to attach a stainless steel safety pin to the catheter 0.5 cm distal to the glans penis. A sterile keyhole gauze is placed under the pin and a split strip of adhesive tape then passed over gauze and pin to be attached ventrally and dorsally on the penile shaft. A circular strip is next placed *loosely* around the penis to secure the longitudinal tape and the ends of all tapes are folded under to facilitate their removal (Fig. 236).

This method has the advantage of allowing the gauze to be changed daily or whenever it becomes soaked in secretion. The catheter remains firmly fixed and is easy to clean since no tape adheres to it.

There are a variety of reasons why we do *not* routinely use balloon catheters:

1. The balloon may obstruct the flow of secretions from the cavity into the bladder.
2. A vulcanized rubber Tiemann catheter has a wider lumen than a balloon catheter of the same size.
3. The walls of the catheter are more rigid, rendering it easier to evacuate occasional coagula. Softer catheters may easily collapse.

Any mild encumbrance by the somewhat rigid catheter is easily outweighed by its advantages.

c) Catheterization in the Presence of Venous Hemorrhage (Venous Sinuses)

In this situation we use a balloon catheter for the purpose originally intended by Foley, i.e., hemostasis. This will only be successful if the venous sinus lies within the prostatic cavity where it can be compressed by inflation of the balloon. I am unable to see the logic behind the suggestion by BAUMRUCKER (1968) that the balloon be placed at the upper margin of the cavity. Neither the margin of the cavity nor the internal meatus, in fact no part of the internal sphincter region, is the site of bleeding. Wide caliber veins *within the cavity* are the culprits, and only if these are compressed will balloon catheterization be of any avail. The truth of this is easily seen if one attempts to follow BAUMRUCKER's instructions, which we did repeatedly after reading his book. After several attempts, characterized by unabated continuation of bleeding, we were forced to return to our old ways.

At the same time our technique of passing the catheter and retracting it into the prostatic cavity follows a strict set of rules which I have found to be foolproof and therefore give in the following:

The balloon catheter is passed into the *bladder* (in the same fashion as described for Tiemann catheters). Its position is then regulated in the usual way and the balloon filled with 20 ml of water. The catheter is next gently withdrawn into the cavity and progressively inflated further, 1 ml of water being added for every gram of tissue resected. For small adenomas therefore an additional 5–10 ml are added, for larger adenomas of over 30 g, 15 or maximally 20 ml, whereas for an adenoma of 70 or 80 g, the total volume could be 85–100 ml (Fig. 237). Inflation of the balloon is accompanied by traction on the catheter, a synchronized procedure requiring two people. One hand maintains gentle tension on the as yet incompletely inflated catheter, the spigot is removed and the bladder drained. It is then twice irrigated with 50 ml sterile isotonic solution (TUR irrigating solution) and on each occasion completely emptied by suprapubic pressure. Only thus can the hemostatic effect of the catheter be tested. As a rule irrigating fluid will be returned virtually clear, but if it is still unacceptably blood stained, traction or the inflation volume may be increased slightly, but not excessively. An undesirable effect may otherwise arise as traction causes the overinflated balloon to fold against the inlet holes of the catheter and obstruct the drainage of urine (Fig. 238).

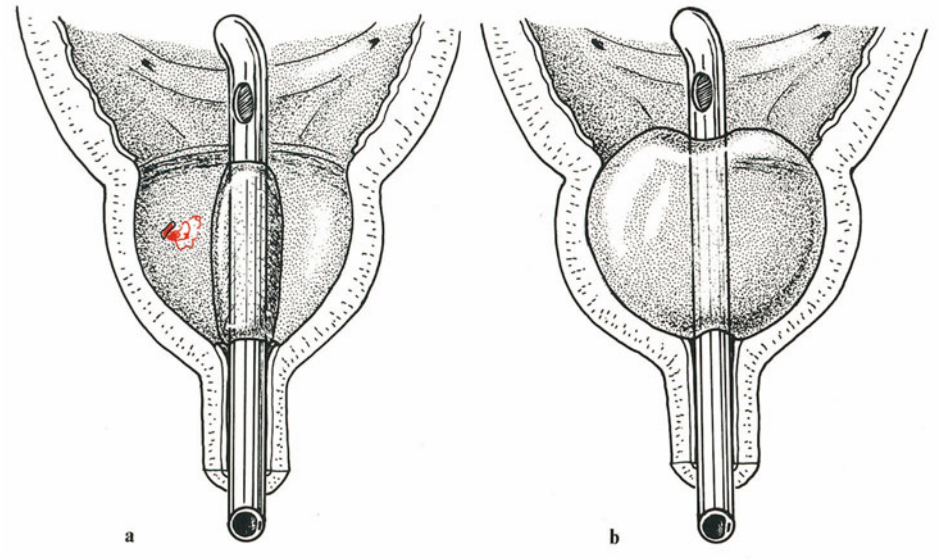


Fig. 237a, b. Inflating a catheter balloon within the cavity in the treatment of venous sinus hemorrhage. **a** The catheter has been correctly placed in the cavity and the balloon slightly inflated. This prevents it from slipping backwards out of the cavity. **b** The balloon is now further inflated, 1 ml water corresponding to a gram of resected tissue

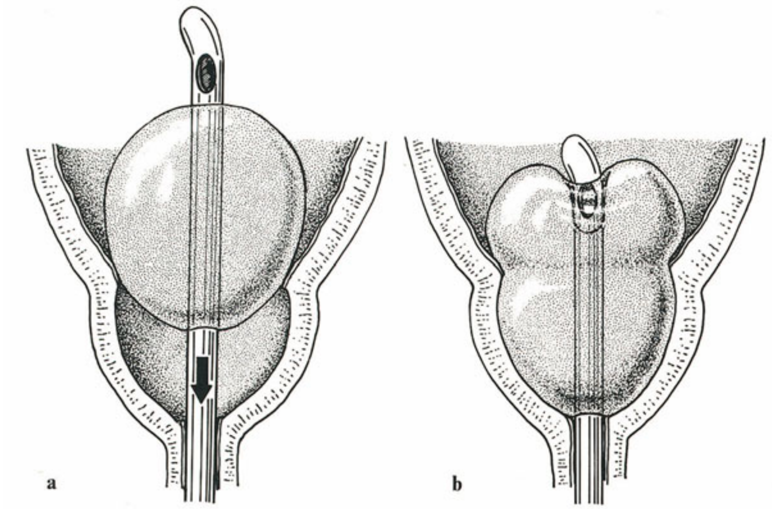


Fig. 238a, b. Incorrect retraction of the balloon catheter. **a** The balloon has been overinflated within the bladder and thus has to be drawn back through the internal sphincter into the cavity. **b** The balloon will fold up around the catheter inlet holes and prevent easy drainage of urine and irrigating fluid. Solution: partly deflate the balloon, gently draw it back towards the external meatus and refill it with the correct quantity of water. No traction should be exercised until the balloon has been inflated by at least $^2/_3$ of the required amount

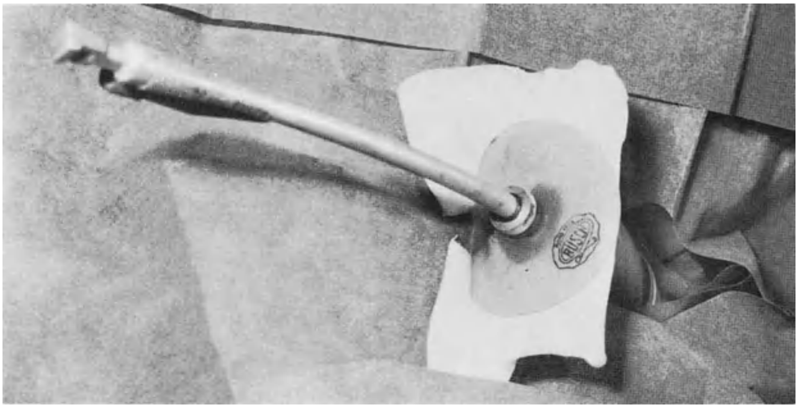


Fig. 239. Securing a balloon catheter under traction. A plastic disc is attached to the catheter by means of a screw cone and thus allows continuous traction on the catheter, e.g., in the presence of venous sinus hemorrhage. Traction is released by loosening the nut. With this device the patient is freely mobile in bed and is spared a weight and pulley or attachment of the catheter to his thigh

There are thus two variables involved in hemostasis: traction on the catheter and the degree of balloon inflation. The catheter itself must of course be suitable for the required volume. There is no point in trying to inflate a 5 ml balloon with 50 ml or a 50 ml balloon with only 10.

Various suggestions have been made on how best to fix the catheter under traction: attachment of the catheter to the thigh with adhesive tape, traction on the catheter by a weight and cord hanging over the end of the bed, wrapping the catheter with a thick gauze tape at the glans. We employ a special plastic disc developed by a senior nurse at our clinic, which allows traction to be relaxed or increased by means of a locking device at its center. This is released, tension on the catheter adjusted, and the disc then locked in position once more (MAUERMAYER and ZIERER 1976). This device is also a great help to our ward staff. After 2 h of traction a quantity of fluid is removed from the balloon and traction somewhat relaxed. If the sinus then starts to bleed again, traction and inflation are easily restored to their previous configuration (Fig. 239).

I should emphasize once more that we use the balloon catheter only as a hemostatic device, and it could therefore be changed once bleeding has ceased.

The short duration of catheterization seldom makes this necessary. If one tests the position of the balloon within the prostatic cavity by inflating it with contrast medium rather than water, its perfect adaptation to the shape and size of the prostatic cavity is easily seen. Subsequent removal of half the inflation volume to some extent allows secretions to drain from the cavity, but not as well as would a Tiemann catheter. Before the patient leaves the operating room the catheter is connected to a closed, sterile irrigating system, so that this particular risk of infection is taken care of under optimal conditions.

2. Irrigating the Bladder

Bladder irrigation usually serves only as a check on catheter function. In closed systems this is achieved simply by opening the inlet and closing the outlet hose and vice versa. Small clots are freed by pumping the tube. If the patient is properly monitored it is quite rare for a catheter to become blocked.

Should this nevertheless occur, various procedures may be undertaken. Irrigating systems are commercially available with a built-in rubber bulb powerful enough for the evacuation of quite firm clots.

3. Evacuating Clots from the Bladder

On occasion, however, this system may be inadequate. The catheter then needs to be disconnected from the irrigating device and the clot evacuated with a bladder syringe. Naturally aseptic technique should be observed. Tamponade of the bladder may arise whenever a more or less vigorous hemorrhage goes unnoticed, so that the blood coagulates into large clots within the bladder, in which case the same technique may be employed. First 50 ml are injected into the bladder under pressure. This has the effect of breaking up clots which may then immediately be evacuated by vigorous suction with a 100 ml syringe. Experienced nurses who have spent some time on a urological ward develop considerable dexterity in this technique. The rate of bleeding will not decrease until the bladder has been completely emptied of coagula, and only then will the closed irrigating system be adequate. It is therefore preferable to use the irrigating system rather frequently and evacuate small clots by pumping the tubes rather than to wait until a large quantity of clot has accumulated, which can then only be extracted by opening the closed system.

4. Vigorous Reactionary Hemorrhage on the Day of Operation

Correct estimation of the rate of blood loss frequently presents difficulties to the inexperienced. It is quite pointless to expect to control a reactionary hemorrhage of any proportion merely by irrigation. For some time now we have taken to operative hemostasis at the earliest possible time in such cases. Although such a procedure will only be necessary in a small number of patients, they will lose far less blood and suffer considerably less discomfort than arises from continuous irrigating and manipulating of the catheter. In these cases one nearly always finds a spurting artery. Over the past years I have seen a number of cases where an artery was bleeding which I was absolutely certain of having previously coagulated and closed. This impression was confirmed by the finding of crusted periarterial tissue. The patient is anesthetized and the resectoscope passed. There is nearly always clot retention and this should first be evacuated. A large number of blood clots may be found in the field of resection, frequently so firmly attached to the tissue as to be irremovable by the resectoscope loop unless current is applied. This cleaning of the bladder and the resection field is the most time consuming part of the revision procedure, and the bleeding vessel is frequently hidden under particularly dense coagula. All clots should be removed, either by the use of cutting current or with the cold loop, and then evacuated from the bladder. The last remnants are more easily extracted by first visualizing them and then removing the electrotome whilst keeping the sheath steady and then attaching the evacuator. The remainder is simple. The bleeding vessel is easily seen in the otherwise bloodless field and is once more closed by a more profound and extensive coagulation than usual. The returned irrigating fluid should then become macroscopically free of blood, since all the small veins will already have closed. The whole operation rarely takes more than a quarter of an hour and should be preferred at an early juncture to frustrated attempts at bladder irrigation.

5. Postoperative Fluid Intake (Management of Irrigating Fluid Overload)

We generally like to enhance diuresis by intravenous fluids and the administration of frusemide. Since a certain quantity of fluid always enters the circulation through open veins in the operative field during any resection, particularly its final phases, there will be a certain reserve volume of fluid available. The excretion of this fluid performs the task of 'internal irrigation' of the bladder. Thus any additional intravenous fluid, half of which should always be physiological saline, will combine with absorbed irrigating fluid to give rise to a very considerable postoperative fluid excretion, tending to counteract the formation of clots. The standard dose of 20 mg frusemide should not be exceeded, and further treatment only initiated if laboratory investigations reveal hyponatremia, or if there are other signs of pronounced hemodilution (raised central venous pressure, raised systolic and diastolic pressures) (p. 412).

Fluid intake and loss should be carefully recorded. Special attention should be paid to potassium replacement, since frusemide is kaliuretic. Special medical problems arising in the high-risk patients who constitute an increasing proportion of our practice will need to be managed in close collaboration with the advising physician. Because of the frequent reports in the literature both we and our anesthetists are constantly on the watch for dilutional hyponatremia. It appears to be subclinical in our practice.

6. Management of Urinary Infection

a) Preliminary Considerations

We only prescribe antibiotics if there was a preoperative urinary infection or the patient is at particular risk, e.g., in the presence of upper tract damage following prolonged retention. Previously infected patients are treated for 2 days preoperatively with high-dose infusions of the appropriate antibiotic, once sensitivity reports are available. We do *not* indulge in prophylactic vasectomy except after a prolonged period of catheterization on an outpatient basis. Where chronic retention makes such management unavoidable, vasectomy is undertaken prior to catheterization, also on an ambulant basis. Because of our trend towards suprapubic puncture these cases have become progressively rare. Serious urinary infection, epididymitis, paraurethral abscess and severe urethritis have become so rare that we look on their occurrence as a great event. We had feared that increasing use of internal urethrotomy to facilitate passage of the resectoscope would be complicated by urethritis, but this never seems to happen. At the same time it should be said that we never cease to seek improvement of the general standards of hygiene in our unit, and the two spheres of surgery and ward care are subject to continuous bacteriologic monitoring.

For completeness, however, infective complications are nevertheless discussed in the following.

b) Paraurethral Abscess

This syndrome virtually only occurs where the catheter has for some reason had to stay in the bladder for a prolonged period of time, and it is usually restricted to debilitated patients. The clinical picture is usually one of unexplained pyrexia without local symptoms, and the site of election is the penoscrotal angle.

Once considered, the diagnosis is easily made by palpation and milking of the urethra, and by superficial inspection of penis and scrotal root. Milking the urethra produces copious secretion.

The therapeutic attack should be two pronged. Bacteriologic examination of urethral secretion will provide data for specific antibacterial therapy. The catheter should be removed and an antibiotic solution instilled twice daily into the urethra, where it should be kept for 20 min by a penile clamp. If the patient requires a urinary diversion this should be by suprapubic puncture, thus short-circuiting the urethra.

c) Severe Urethritis

This ailment may occur in advance of paraurethral abscess and its treatment is therefore the same. Internal urethrotomy allows such good drainage of urethral secretions that urethritis has virtually disappeared from our unit since its introduction.

d) Cavernitis

In rare cases inflammatory change of the urethra may spread to the corpora cavernosa. The syndrome is unmistakeable and is also extremely painful, requiring both high-dose antibiotic therapy and the administration of an anti-inflammatory agent with local compresses of dilute alcohol. The prognosis would appear to be good, and in the few cases of which I have personal experience there was always complete regression and subsequently normal erectile capacity.

e) Epididymitis

Although it has now for many years been our practice to restrict vasectomy to the cases already mentioned, epididymitis has become rare. Perhaps the reverse statement would be more accurate: we no longer undertake routine vasectomy because epididymitis is so rare.

Early epididymitis is occasionally successfully treated by novocaine block of the cord. In more advanced cases our first line of treatment is the application of leeches. Three or four are placed on all reddened areas of the scrotum, starting with the cord if this is involved. The response is frequently remarkable. Pain and swelling rapidly subside and pyrexia abates. This leeching should always be combined with the administration of antibiotics and anti-inflammatory agents. Epididymectomy may be a good early treatment to prevent the extension of inflammatory change into the periorchium in some cases (age, septic condition, reduced resistance in elderly men).

For completeness it should be pointed out that epididymitis may also occur in vasectomized patients.

7. Postoperative Mobilization

In principle patients could get out of bed on the evening of operation and walk around their room. We rather discourage this because it would mean opening the closed irrigating system and spigotting the catheter. The longer this system remains closed and 'protected from the outside world' the more easily postoperative wound infection is avoided. For this reason our patients mobilize on the postoperative day and usually sit out at the breakfast table. They get out of bed thrice daily and take short walks, limited to 15–20 min by spigotting of the catheter. The extent to which the procedure thus takes on an outpatient character surprises even us. Quite elderly patients who were fully mobile and mentally active prior to surgery respond just as the younger ones. The extent of resection appears to be of no influence as long as blood loss is minimized.

8. Removing the Catheter

In the majority of cases we remove the catheter on the second postoperative day, very rarely on the first. The duration of postoperative bleeding is the main determinant factor, and even patients who required a balloon catheter because of an open venous sinus are treated in the same fashion. Prior to removal of the catheter the bladder is given a final irrigation, to prevent residual clots in the base of the bladder obstructing subsequent micturition. The catheter may safely be removed even if the urine is not entirely clear of blood: a mild pink tinge is not a contraindication as long as the patient dilutes his urine by maintaining a brisk diuresis ('internal irrigation').

9. Assessing the Result

The absence of residual urine following micturition may be confirmed in two ways: firstly the bladder may be filled with a known volume prior to removal of the catheter. The patient then urinates into a volumetric vessel, and the missing volume will correspond to the residual. The second method is recatheterization after micturition.

We prefer the first test, since it obviates repeat catheterization of the patient.

Sensitive patients may take some time to become accustomed to micturition without a catheter. Fear of pain causes them to activate the sphincter frequently and they drink little in an attempt to avoid painful and unaccustomed micturition.

The administration of psychoactive drugs may improve this situation, imipramine (Tofranil) being very suitable in our experience. Micturition is nearly always mildly painful on the first few days although this improves if the urine is kept dilute. A mild pricking sensation in the glans is also frequently reported. There is initially *always* some frequency, both day and night.

The most important criterion of successful surgery is the quality of the urinary stream, so we measure this with a TAMMEN uroflowmeter 3–4 days after removal of the catheter. A poor stream and frequent micturition are almost invariably signs of a residual urine.

10. Recatheterization

Very few patients have such severe trouble with micturition as to require fine catheter drainage for a further 2–3 days. The surgical wound may be unusually inflamed or edema around the new internal meatus may be a true obstacle to micturition. We cover this period of renewed catheterization with antibiotics (according to sensitivity report) and anti-inflammatories. To exclude further clots as the source of micturition problems, the bladder is irrigated yet again.

After this 2- or 3-day period of further catheterization the vast majority of patients are able to pass urine with a good stream and leave the clinic a few days later.

11. Postoperative Medication

Absence of pain is one of the chief characteristics of transurethral surgery. Patients are always surprised to feel no wound pain, and if pain should occur during the first few days while the catheter is still in situ, one should reach for the bladder syringe rather than the injection syringe, since catheter blockage is more likely to be the cause. Typically there will be clot retention with overdistension and catheter blockage. Re-establishing free drainage and thus emptying the bladder then dispels pain without the need for analgesia.

Acute infection occasionally gives rise to pain which is usually felt in the perineum or around the glans penis. In such cases dipyrone remains indispensable. Daytime frequency and nocturia with a good stream and in the absence of residual urine should be treated with the appropriate antibiotic (sensitivity report) and a suitable agent to 'rest' the bladder. We have found 'Urispas' to be satisfactory and have taken to giving a suppository at night. More nervous patients occasionally need to check at frequent intervals that they can still pass urine freely and so they go to the lavatory every 10–20 min, upsetting both themselves and their surroundings. Once again we have no compunction in prescribing psychoactive agents, and in this situation Limbatril tablets are our usual choice because of the ease in adjusting the dose.

Opiates and similar powerful drugs are not usually required, except for carcinoma cases, and should only be employed under exceptional circumstances.

12. Repeat Resection for Poor Stream

Patients should only be allowed home when they can pass urine in a good stream (measured!) and empty their bladder without residual. If this is not the case, if there is pronounced frequency, residual urine or a poor stream it is wrong to console oneself and the patient with excuses such as 'it will go on improving, it will all come right, there's just a little swelling.' The patient was frequently able to pass urine quite satisfactorily on the first and second day after removal of the catheter, and his stream only subsequently deteriorated. These patients should have their bladder neck inspected under anesthesia and any small tissue residue or even remaining apical tissue should be removed. It is frequently patients with small adenomas or bladder neck fibrosis who require this second look.

Sometimes the bladder neck gives the impression of complete dissection and the absence of any further removable tissue. Nevertheless there must be a reason for the poor stream.

If the paracollicular region of these patients is inspected more carefully, a 'trial cut' may reveal a thin residual band of adenoma tissue left behind. Once this has been removed in one place, it is more easy to see where it remains elsewhere.

This apparent poor assessment of the bladder neck at the first operation arises as follows: resection was undertaken properly, but in the apical region of the prostatic cavity a thin layer of tissue was left behind, and gradual retraction of the fibromuscular capsule some days after removal of the catheter gradually presses this tissue into the urethral lumen. It is therefore precisely patients with a small bladder neck who give little room for maneuver when operating in the paracollicular region.

Even the most careful inspection frequently fails to reveal more than 2–3 g of removable tissue. The procedure takes only a few minutes and represents virtually no setback for the patient, delaying discharge maximally 2–3 days.

II. Postoperative Management of Operative Complications

1. Postoperative Management of Perforation

a) Postoperative Management of Extraperitoneal Perforation

If the site of perforation in the prostatic capsule has not been sutured, treatment being restricted to periprostatic drainage or even to no additional treatment, bladder irrigation should be undertaken with great care, only small quantities of fluid being used. In these cases it is mandatory to give antibiotic therapy, even if the urine was sterile preoperatively. The catheter should be left in situ for a week and prior to its removal a careful contrast cystogram should be carried out under the image intensifier, in order to prove that the site of injury is now watertight.

If surgery had to be discontinued because of a perforation it will need to be concluded at a second sitting after a further week's delay, i.e., 14 days after the original procedure.

If perforation occurred at the end of the original procedure after the removal of all adenoma tissue, the patient may be discharged as soon as he is able to empty his bladder without residual.

Cases requiring suture of the perforation have always suffered the more extensive injury, and it is therefore not surprising that they take somewhat longer to heal. Once again bladder irrigation requires great care. The catheter should be left in situ 1–2 weeks from case to case, and a cystogram performed prior to its removal as described for the previous situation.

b) Postoperative Management of Intraperitoneal Perforation

I have only come across this type of injury in relation to the resection of bladder tumors, not of the prostate. The sequence of events, however, is the same. The site of perforation always requires suture, and depending on the presence of urinary infection the peritoneum may need to be drained. The basic principles of postoperative care are proper antibiotic cover of infection and standard treatment as for any abdominal surgery. We have never had postoperative problems following perforation during resection of bladder tumors and have consequently never had a death. On the other hand MARBERGER (1978) has reported cases of carcinomatosis peritonei following this accident: our cases have never suffered this complication. The abdominal drain may be shortened and removed once its output decreases, and the same goes for any other paravesical drain inserted because of the presence of irrigating fluid. No doubt, wounds occuring during prostatic resection heal with fewer problems than those arising from perforation of a bladder tumor. In the latter case we have occasionally seen delayed healing where it was necessary to suture tumor tissue and where peritoneal cover was difficult to obtain.

2. Postoperative Management of Ureteric Orifice Trauma

Once again, any increase in intravesical pressure during irrigation should be avoided, since vesicorenal reflux and renal sepsis might ensue. The catheter is removed at the usual time, and check cystoscopy 14 days later usually allows the future course to be predicted: a broadly gaping orifice nearly always indicates future reflux. Whether or not such severe stenosis will develop as to require reimplantation of the ureter can usually only be perceived after several weeks. The majority of cases heal without complication, i.e., without stenosis or reflux, unless the original injury consisted of several deep incisions into the intramural ureter.

3. Postoperative Management of External Sphincter Injuries

This injury is only rarely noted at the time of surgery and usually manifests itself as incontinence on removal of the catheter.

The single precaution to be taken following peroperative diagnosis of such an injury is the absolute prohibition of balloon catheterization under traction. In the theoretical situation where an external sphincter injury is vitiated by the opening of several venous sinuses, I would prefer to pack the wound cavity by the suprapubic route and perform temporary cystostomy rather than further embarrassing the weakened sphincter by traction on a balloon catheter.

4. Postoperative Management of the TUR Syndrome

Some of the therapeutic problems in this situation may be so acute and urgent as to require treatment based on a diagnosis of suspicion. Dilutional hyponatremia should be suspected where the central venous pressure is raised, where the systolic and diastolic blood pressure are simultaneously raised and, if the patient underwent regional anesthesia, where restlessness and confusion are unmistakeable. Should pulmonary edema supervene, this will be apparent as dyspnoea, air hunger and cyanosis. General anesthesia tends to obscure a large proportion of the otherwise pronounced subjective symptoms. The definitive diagnosis rests on a substantially reduced plasma sodium concentration (less than 120 mmol/l).

Treatment cannot be delayed until the availability of the sodium estimation and standard treatment should be immediately instituted by the administration of 250–500 ml of 5% sodium chloride solution with an initial dose of 40 mg frusemide. Once the chemistry has returned to normal, the patient may be treated in the standard fashion, although his electrolytes and blood pressure should be checked more often than usual and a chest radiograph performed. Once the excess water has been excreted and other biologic measurements have returned to normal, the danger is over, and the patient may be returned to an ordinary ward.

I should add that I have no personal experience of this therapy and therefore report what is described in the literature. Despite considerable vigilance we have never seen a typical case of this syndrome, although we undertake over 600 transurethral resections of the prostate per year.

III. Postoperative Complications

1. Preliminary Considerations

The most important postoperative complication remains hemorrhage in its various forms. Reactionary hemorrhage on the day of operation, or perhaps 1 or 2 days later due to dissolution of diathermy crust, has already been discussed. The event is unmistakeable and requires immediate action, i.e., operative hemostasis. Hemorrhage 10 or 14 days later is somewhat rarer but should nevertheless be regarded as a dangerous situation. Once again the severity of hemorrhage and its concomitant of clot retention renders it unmistakeable.

Particular postoperative attention should attach to any persistent ooze, even if it is not so profuse as to require immediate action but is nevertheless too pronounced to allow removal of the catheter. In the following we shall use the term ‘prolonged oozing.’

Three other types of hemorrhage may occur prior to discharge from hospital:

1. *Severe profuse* hemorrhage, as already mentioned
2. Hemorrhage of a sufficient rate to color the urine dark red but not adequate for the formation of clots. This might be described as *moderate hemorrhage.*
3. Transient macroscopic hematuria, *mild hemorrhage*

Microscopic hematuria is a typical phenomenon of the recovery period and may last up to 6 weeks, only being detected on appropriate testing and characteristically limited to the initial fractions of a given voiding.

2. Persistent Oozing

If the urine fails to clear 4–5 days after electroresection there is no point in waiting any longer, and the bladder should be examined under anesthesia, with operative hemostasis as required. This approach of *early* intervention has arisen because of our experience that further waiting is *always* unsuccessful and only results in an unnecessary waste of blood and time. Examination under anesthetic either reveals a few clots in the cavity and on the base of the bladder, or the entire cavity is lined with tough, adherent coagula, difficult to remove except by the use of cutting current. If one examines these clots after their removal they may be found to be rubbery, rather like chewing gum. An actual bleeding point is rarely found, and evacuation of the clots or clearing out of the cavity concludes the procedure. Hemorrhage from a few small veins should be arrested, although it is usually difficult to say whether they were opened during the second procedure or had been bleeding all the time under cover of adherent clots. Hemostasis will then be complete, and catheter left in for safety may be removed on the following day.

I definitely recommend this active approach. We also employ it in the management of similar bleeds following enucleation.

3. Moderate Hemorrhage

This is characterized by the absence of clots and therefore by unimpeded micturition. Hemorrhage nearly always occurs within the first 10 postoperative days and requires only an increased fluid intake rather than any active treatment. I have so far been unable to prove to my own satisfaction whether the administration of antifibrinolytics (epsilon aminocaproic acid) has any reproducible effect. I suspect that this agent merely treats anxiety in patient and surgeon. Hemorrhage usually ceases spontaneously after 1 or 2 days.

4. Mild Hemorrhage

It is without significance and usually disappears after several voidings. If patients are led to expect this phenomenon, they will wait without undue anxiety for its disappearance. This type of hemorrhage does not require any treatment and arises during the healing process in relation to slough separation.

5. Microscopic Hematuria

This is only detected by microscopic or chemical urine examination. The healing wound is covered in granulation tissue from which, quite normally, leucocytes and red cells escape. The phenomenon ceases on completion of epithelialization.

6. Infective Problems

As far as we can tell from our own patients, these situations have become extremely rare. Whether this is due to improved aseptic technique, to better resistance among patients or to the prescription of routine antibiotic therapy, will only emerge from further observation.

The principle types of infective complication have already been described in relation to urinary infection.

7. Catheter-Induced Bladder Spasm

In a few patients the indwelling catheter may give rise to severe spasms which become a dominant symptom. There are two separate therapeutic avenues: optimal regulation of catheter position and drug therapy.

a) Regulating Catheter Position

Proper adjustment of catheters is an art which I myself had to learn from long-serving nurses in our unit. They were certainly superior to us young surgeons in their experience of this technique, to which they attached considerable pride.

The most frequent cause of spasm is the catheter touching the posterior wall of the bladder and stimulating it. The truth of this concept is demonstrated by the degree of catheter edema to be observed on the posterior wall of many patients' bladder after a long period of catheterization.

If an open-ended catheter is so adjusted that its tip only just projects into the bladder, then this maneuver alone will reduce the tendency to spasm or abolish it altogether. Patience and dexterity are indispensable.

b) Drug Therapy

Alternatively a pharmacological attack may be mounted: the simplest method is simple local anesthesia, but this will only be safe in the absence of any open wound through which the drug could be absorbed. Amethocaine is one of the most effective, and should be employed in 0.5% sterile solution. 10 ml are instilled into the bladder and the catheter then spigotted, the treatment initially being repeated hourly. After 'desensitization' has occurred this may be stretched to once every 1–2 h and subsequently to thrice daily.

Equally one may administer Bellergal, Urispas or dipyrone. I remember a few cases in which papaveretum was effective where all else had failed.

8. Urge Incontinence

Urgency is occasionally confused with incontinence because patients complain they are 'unable to hold their water.' Such complaints should always be checked by filling the bladder with a volume of fluid corresponding to the patient's bladder capacity – perhaps 200–250 ml – and then asking the patient to cough. Patients with urge incontinence are 'water tight' during this test, and cystourethrogram reveals a normal arrangement (impression by the external sphincter).

Urge incontinence nearly always results from severe inflammatory change around the bladder neck and/or bladder and improves spontaneously following appropriate treatment of infection and reduction of inflammation.

IV. Late Complications After Transurethral Surgery

1. Preliminary Considerations

Like any other operative technique, electroresection of the prostate and of bladder tumors gives rise to complications specific to the method.

First and foremost is urethral stricture, with an incidence of 2%–3% (depending on author), and this may result either from technique of instrumentation or from subsequent catheterization (open prostatectomy also has a stricture rate!). Certain types of stricture may be avoided by appropriate precautions, and recent years have seen a revival of vigorous discussion on this topic.

The recurrence of residual volumes and the reappearance of urinary symptoms also relate to late complications.

2. Urethral Stricture

Without any doubt the urethra is considerably more delicate than was assumed only a few years ago. Even improper catheterization may in itself give rise to stricture.

The sites of election of postoperative stricture are:

1. The external meatus
2. The transition from the navicular fossa to the penile urethra

3. The penoscrotal angle
4. The transition from the membranous to the prostatic urethra
5. The internal meatus

Attention was drawn in Chap. C (p. 94) to prophylactic maneuvers. Since rigorously performing internal urethrotomy at every point the sheath was unable to pass under its own weight, we have reduced our own stricture rate from 8% to 2%. By the same token internal urethrotomy has become the most frequent method for the treatment of postoperative strictures, because of its ease, its good results and its ease of repetition in recurrences (see also Chap. L).

3. Internal Meatal Stenosis

a) Preliminary Considerations

Iridiform stenosis of the internal meatus represents a special type of urethral stricture. It may occur months after surgery and result in progressive reduction of a previously excellent urinary stream.

Cystourethrogram reveals a short narrowing at the site of the internal meatus, distal to which lies a small prostatic cavity. These findings will be confirmed on urethroscopy: proximal to a small prostatic cavity lies an almost completely closed internal meatus, only a pinhole communicating with the bladder.

b) Treatment

A stenosis may be corrected in a variety of ways (see p. 389).

α) Retrograde Incision with the Resectoscope Loop. Although elegant this method is doubtless the more difficult. The resectoscope is brought up against the stricture and the loop advanced into contact with the scar plate. Cutting current is then applied and the loop pushed through the obstacle. The procedure needs to be repeatedly interrupted for the clearance of gas bubbles arising when the current is switched on. Because of the small cavity they are not easily washed away. On the second or third attempt the tissue suddenly gives way and one enters the bladder. This description of the procedure sounds somewhat adventurous but is really quite safe because of the pronounced ventral projection of the obstacle above the base of the bladder.

Once a way has been found into the bladder additional cuts are placed to dissect out the internal meatus. The stricture consists entirely of pure fibrous tissue like any other scar.

There is therefore little hemorrhage during this procedure.

β) Incision by Wire Probe. A second technique for correcting the scar is incision by a wire probe passed through an operating urethroscope into the pinhole of the 'iris.' Three or four radial incisions are made in a star-shaped arrangement, and the instrument exchanged for a resectoscope. The rest of the bladder neck is then dissected out as just described.

After excising the scar we inject all these cases with 2–3 ml hydrocortisone acetate (25 mg/ml) in individual portions of 0.1–0.2 ml into the scar tissue, the aim being to prevent further scarring.

A few of these cicatricial rings have a marked tendency to recur. After the third recurrence YV plasty of the bladder neck may be the only remaining solution.

γ) "Cold" Incision with the Sachse Knife. The third technique is 'cold' incision of the stenosis with the SACHSE operating urethrotome. A star-shaped incision is made down to the sphincter margin in 3 places. Hemostasis of the usually minute vessels should be extremely cautious if further necrosis is to be avoided. Since employing this technique we have seldom had to proceed to YV-plasty.

The latter is rarely indicated. In 600–700 electroresections of the prostate per year a case only arises in every 1–2 years.

4. Recurrence of Urinary Symptoms

Such an event is equally unpleasant for both patient and surgeon. There are two possible causes within the prostatic urethra:

1. True recurrence
2. Residual bulging adenoma tissue following incomplete resection

True recurrences are rare but nevertheless occur. They may be recognized endoscopically by the presence of a large spherical nodule of adenoma bulging into the lumen in the absence of any evidence of previous surgery. Such recurrence is easier to accept after an open operation, since it is reasonable to assume that all adenoma tissue had been removed. That may not of course be the case. Once or twice I have had to resect one or other lateral lobe quite shortly after previous open surgery only to find a bladder neck that looked virtually untouched. If one previously operated on the patient oneself and a postoperative cystourethrogram is still available, the presence of a true recurrence is easily proven.

The second type of recurrence, due to merely palliative resection, is far more frequent. The drainage channel within the adenoma tissue is then easily seen, usually running along the floor of the prostatic urethra. The median lobe has usually been removed and the base of the lateral lobes grooved.

Such cases nevertheless represent recurrences, in the sense that a previously adequate drainage path has been narrowed or obstructed by further growth of adenoma or retraction of the capsule.

In either case meticulous repeat resection is the only treatment.

5. Unyielding Urinary Infection

Frequently a resistant germ is involved and cannot be cleared even with high doses (15–20 g) of appropriate antibiotics, or else it recurs after a short period. When discussing the technique of resection we drew attention to the partial or complete devascularization of inadequately resected adenoma tissue. Such underperfused tissue is an ideal site for infection, since proper therapeutic concentrations of antibiotic cannot be achieved. The chronically inflamed tissue furthermore gives rise to dysuric symptoms, particularly of urgency and frequency.

A decision in favor of further surgery may be particularly difficult to make if the patient has a good stream and is thus quite satisfied with his own micturition. In some such patients furthermore infection is inconstantly present, sometimes proven sometimes not.

The situation is rather easier where the presence of necrotic encrusted tissue can be demonstrated within the field of resection and where there is true pyuria.

In these cases patient and surgeon will soon be agreed on a further operation. In the former type of case histological, cytological and bacteriological analysis of a perineal prostatic biopsy may help to clarify the problem.

Chapter O

Learning and Teaching Transurethral Operative Technique

There are two basic ways of learning transurethral electroresection: one may teach oneself or learn in a training unit.

All the older urologists, i.e., all those at the peak of their profession in the 1930s and 1940s, taught themselves to use the resectoscope. In many cases they were themselves the pioneers of the technique and gave brilliant descriptions of their knowledge. The monographs by BARNES (1943) and NESBIT (1943) remain today much sought-after classics among operation manuals. Prior to the introduction of teaching attachments clinical tuition was difficult for teacher and pupil alike. However hard the teacher tried, the pupil was to some extent left to his own devices. Those with a natural talent soon learned the method despite limited teaching facilities, while the less talented got stuck at a certain technical level and were restricted to using the resectoscope in a limited way, e.g., for small transverse bars or for bladder neck fibrosis. Their appreciation of endovesical surgery remained equally limited.

This autodidactic period was characterized by the fact that the teacher could only ever allow the pupil a brief glimpse down the instrument in illustration of a given situation. With the best will on the part of the teacher, cutting technique had to be practised by the student on his own. Only twin eyepiece telescopes with their requirement for difficult co-ordinated movements allowed any direct supervision. I experienced this period both as a pupil and a teacher.

In addition to all this, the optical quality of the available instruments and the power of the illuminating systems were at that time hardly comparable to our modern equipment.

The period of organized teaching began with the introduction of illumination and observation through fiberoptic bundles referred to in our clinic as the 'spy.'

Proper illumination by powerful light sources and facilities for continuous observation for the first time allowed the entire procedure to be experienced with all the difficulties that may occur. It thus became possible to give direct demonstrations of the elemental techniques of cutting and hemostasis.

It can be no surprise that in the pre-'spy' era various attempts were made at teaching the beginner basic resection technique on a phantom.

One needs only to mention various experiments employing cow's udder (HABIB et al. 1965), bovine heart (BARNES 1959), cadaveric bladders (NARWANI and EVERETT 1969) and a clay model (CONGER 1964).

PIRKMAYER and LEUSCH (1977) have recently published an alternative technique, persuasive by its very simplicity: their idea was to replace animal tissue

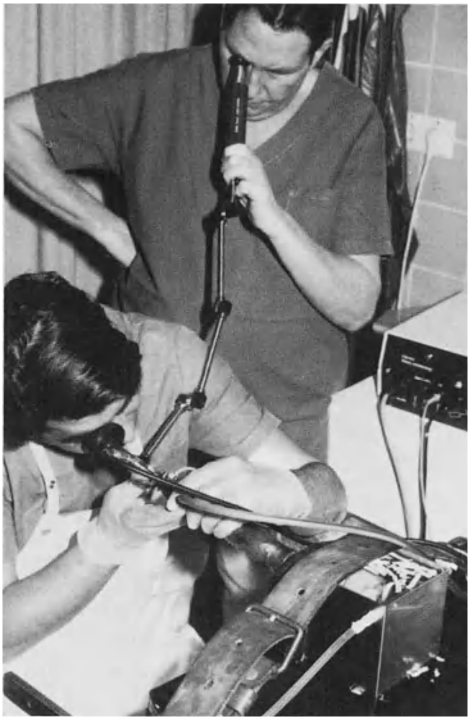


Fig. 240. Teaching model for practising transurethral surgical technique. An apple has been clamped into the metal box so that its long axis corresponds to that of the resectoscope, which is inserted through a rubber grommet. The core of the apple is first removed with a drill. The metal box serves as an indifferent electrode and is connected to the high frequency generator. Irrigating fluid flows through the resectoscope in the usual fashion and drains out of the phantom through a special port. This device allows various maneuvers and aspects of cutting technique (but unfortunately not of hemostasis!) to be practised. A teaching attachment is used to monitor and correct cutting technique

by vegetable matter in the shape of an apple. This has the advantage of certain morphologic similarities to the prostate, being encased in a skin and having a spherical shape. It is also easily cut by high-frequency current. A very considerable degree of simulation is possible: excavation with all its co-ordinated movements can be demonstrated and the short individual or extended cut can be practised on this model (Fig. 240). NESBIT's remark immediately comes to mind that excavating the prostate down to the capsule is similar to spooning out a baked apple.

Admittedly no amount of dexterity on the model can replace actual operative experience. The model is nevertheless a considerable aid to learning and practising control of the instrument.

It is precisely this automatic use of the instrument with all its accessories, such as the footswitch for various currents or for movements of the table, that constitutes an important part of surgical routine. Since most operations consist of a series of repeated maneuvers it is particularly important to facilitate these 'resection reflexes.' The faster and more automatically they come, the more time remains for the actual work of cutting and of hemostasis.

One further point should be considered: large departments and clinics usually have extremely experienced theater staff able to step in and help with changing a resectoscope loop or in identifying the source of a malfunction. This might be, for example, a burnt out lamp in a light source, poor contact on the loop or a cutting cable with a broken core, allowing only limited or no passage of current. The current intensity is also usually set by theater staff.

The budding resectionist must learn all these maneuvers *before* starting to operate on a patient. We go even further and have our young assistants spend 2–3 weeks working in the 'instrument room' so as to learn to dismantle instruments and recognize their individual parts, as well as grasping the basic principles of cleaning and decontaminating them.

Only thus will they still be able to work effectively without the well organized personnel of a teaching unit.

Operative training proper only begins when this basic knowledge has been acquired. At the same time as learning the technical details just mentioned, our students receive their first endoscopic training. No one who has not studied the bladder neck and bladder of at least 100 patients under the guidance of a more experienced assistant can possess the necessary anatomical knowledge to undertake transurethral operations. Learning to see endoscopically forms the basis of all further training. Repeated discussion with older colleagues – and of course study of the literature – should provide the trainee with a spatial concept to which to apply a two-dimensional image. Rectal palpation is one of the simplest additional aids during endoscopy of the bladder neck.

Only at this stage does the observation of endoscopic surgery begin. This should not be limited to the trainee simply watching everything that happens in the operative field. It must be explained repeatedly why this or that is being done. No doubt this represents an additional load on the surgeon performing the demonstration resection, but from a medical point of view it is hard to see a true alternative. Resection with a teaching attachment requires a special operative technique just as was the case when we learnt to operate with color video cameras. It is not so much that the operation is carried out in a different way: there is a continuing requirement to point out landmarks in the operative field, for example, by visualizing the verumontanum and then going on to describe the further progress of the operation. Only thus can the inexperienced surgeon keep track of the whole procedure. I attach great importance to demonstrating how movements of the surgeon's body influence the endoscopic picture. It has to be described for example, how, during excavation of a lateral lobe down to the capsule, not only linear but also lateral movements are required to cut deep into the tissue. During one cutting series the observer may watch the surgeon's movements, and in a subsequent one he will see the corresponding endoscopic situation. Extended and standard cutting should be carefully described, to give but two examples. It is particularly important to carefully demonstrate resection around the prostatic apex, and the necessary accuracy of resection is easy to show.

After observing at least 20–30 procedures the 'surgical pupil' (BILLROTH) will have a good overall understanding of the general sequence. Naturally these demonstration operations should not consist of artistic masterpieces in which a particularly talented and practised surgeon removes 100 g of tissue in less than an hour, they should consist of 'normal' small and medium adenomas. The course of the operation, the techniques of cutting and hemostasis are thus repeatedly demonstrated, just as often as one will demonstrate hernia surgery to a young surgeon.

Only after this protracted preparation does real operative training begin. The carefully prepared trainee now attempts his first operation under supervision. An adenoma with a pronounced median lobe is particularly suitable, since its position at 6 o'clock presents the least difficulties. The first cuts may be made at this point, the resection field being kept clear and worked on systematically. It is the task of the supervisor to see to this by repeatedly insisting on adherence to the overall plan of operation. An uneven operative field is smoothed by the teacher whilst the pupil watches. To begin with we give our young colleagues just 10-min operating time, after which the supervisor takes over and concludes the procedure.

After 10–20 resections, depending on talent, this period is extended to 20 min. This length of time is enough for a dexterous trainee to all but remove a small adenoma, leaving his instructor only a few smoothing cuts and resection of the prostatic apex still to do. Under such supervision the young surgeon gradually develops into a skilled transurethral operator.

After a training period of about 3 months, perhaps twice as long for the less talented, our young colleague may now be left to work more or less on his own, except that final inspection for completeness of adenomectomy and adequate hemostasis still remain the duty of the instructor.

As the trainee develops his abilities he may be entrusted with larger and larger adenomas until he has one day suddenly become a mature transurethral surgeon.

There is one important principle in our clinic which we repeatedly impress on our trainees: from a medical point of view it is preferable, should a difficult situation arise, to call for help early rather than endanger the patient through a false sense of pride. The result of this rule has been that there is no difference in success rates between our younger colleagues and the chief assistants and chief of the clinic. On the other hand such a training system imposes a considerable burden on the more experienced staff, but any other method of teaching this technique is inadequate and will eventually reflect on the establishement where the young man trained.

Despite all enthusiasm for this method of operation it should be remembered that here, as elsewhere, there are those who are talented and those who are less so. The former can be regarded as 'naturals.' They show particular technical dexterity, react rapidly and soon develop the co-ordination required for various work sequences in response to optical cues. While their colleagues who have trained for the same period of time are still having difficulty with 10–15 g adenomas these young men are already resecting 25–30 g adenomas on their own. Thirty years of teaching many generations of assistants has taught me these differences. Yet the conclusion should never be to sink into apathy or even to neglect the 'slow coaches' – they simply need more effort and patience.

The same problem arises when teaching endovescial tumor surgery, which should also not be a haphazard affair. On the contrary, excision of a carcinoma infiltrating the bladder wall so as to clear the muscle coat is a technique requiring careful training and expertise at recognizing various tissues. Unfortunately the quality of image available in teaching attachments is not quite adequate for the demonstration of fine detail. Physical limitations are imposed by the resolving power of fiberoptic bundles and structural details thus sometimes remain invisible. For such purposes a lightweight and freely mobile articulated viewing attachment is available, and we now use this routinely.

Apart from the teaching of transurethral technique in this type of class, textbooks and monographs also provide a way of learning to operate. This method is particularly suitable for improving the knowledge of those who already have some basic understanding. Experienced surgeons will derive particular benefit from such publications, and sadly a number of colleagues still depend entirely on the literature as a source of operative technique, since the number of training establishments is far below the actual requirement. It goes without saying that these various books are a valuable supplement to practical experience for anyone fortunate enough to be in a good training post.

Surgical courses involving video transmission of transurethral operations are also effective and reach a large number of practitioners. Articulated beam splitters, very bright optical systems and powerful illumination nowadays render any endoscopic transurethral operation immediately reproducible live in color. Our department is equipped for such transmissions on a routine basis, and magnetic tape recording has resulted in an archive on which we can draw for teaching purposes in addition to live transmission.

It is reasonable to ask whether such courses should use video projectors to allow the maximum number of participants to both see and hear the progress of a transurethral operation in a separate lecture theater, or whether it is better to restrict oneself to teaching a small number of people in a more individual fashion. After almost 5 years' experience we have come to the conclusion that small groups are preferable.

These thoughts on the methods of teaching electroresection clearly show just how difficult the technique is. At the same time we are not seeking to propagate a secret art known only to a few 'high priests' after suitable devotions. What we actually have is a technologically advanced method which anyone may learn who is suitably taught. Without this technique modern urology would simply be the appendage of general surgery concerned with solving surgical problems in the urinary system.

Color Plates

Ill. 1. General view of the bladder neck seen from a point distal to the verumontanum. The transition is easily seen from urethral crest to verumontanum, the latter bulging into the urethral lumen. From a case of transverse bar with virtually absent lateral lobes. Proximal to the verumontanum the floor of the prostatic urethra rises steeply. The summit of the transverse bar is not clearly visible, lying ventral to the field of view. On the other hand the 'gothic arch' configuration of the transition from prostatic to membranous urethra is clearly shown. The orifices of prostatic glands may be seen between the verumontanum and the vestigial lateral lobes

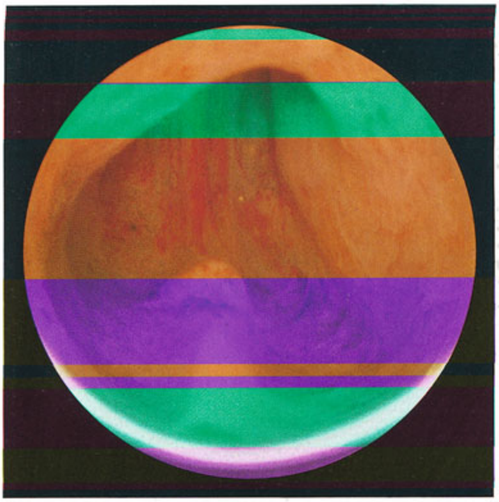
Ill. 2. General view of the bladder neck. From a similar position to that of Ill. 1. The urethral crest is strongly developed and its proximity to the front lens of the telescope leads to further distorted magnification. The verumontanum itself is considerably more proximal and may be recognized by the small pit of the utriculus lying between the lateral lobes. This picture illustrates the proximal position of the verumontanum in relation to the distal extremity of the lateral lobes. The transition point between prostatic and membranous urethra is once again clearly seen in the ventral region. Moderately developed lateral lobes bulge into the urethral lumen

Ill. 3. Verumontanum in a case of small, short transverse bar. The verumontanum projects into the urethral lumen as a landmark. The arch of the transition between prostatic and membranous urethra is again well seen. The rising fold of the transverse bar is clearly seen proximal to the verumontanum

Ill. 4. General view of the transition from prostatic to membranous urethra. Ventrally, an air bubble and beneath it the arch denoting transition from prostatic to membranous urethra. This region is thrown into typical folds (Nesbit sign) as the sheath is advanced and retracted. As is usually the case, the verumontanum here lies somewhat proximal to the boundary arch and between the lateral lobes, the bases of which it forced apart. Close proximity of the urethral floor mucosa makes it seem edematous and redundant

Ill. 5. Bladder neck seen from the level of the verumontanum. The cutting loop is somewhat advanced to give an impression of its dimension in relation to the bladder neck structures. The end of the instrument is approximately opposite the lower border of the verumontanum. The prostatico-membranous transition arch is well seen and proximal to this the beginning of the lateral lobes, with the cleft demarcated by their medial extremity and the flanks of the verumontanum. Ventrally there is a short area of contact between the lateral lobes (same patient as Ill. 4)

Ill. 6. Further advancement of the instrument up the prostatic urethra. The lateral lobes swing apart laterally and the large median lobe is seen rising up shortly above the verumontanum. A small flake of fibrin has become attached to the loop and there is a small blood clot to the left on the floor of the prostatic urethra



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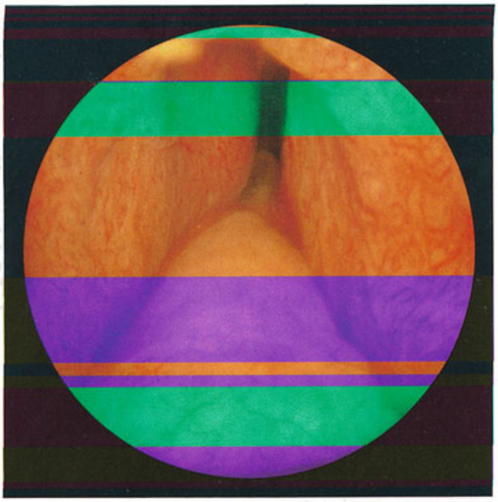

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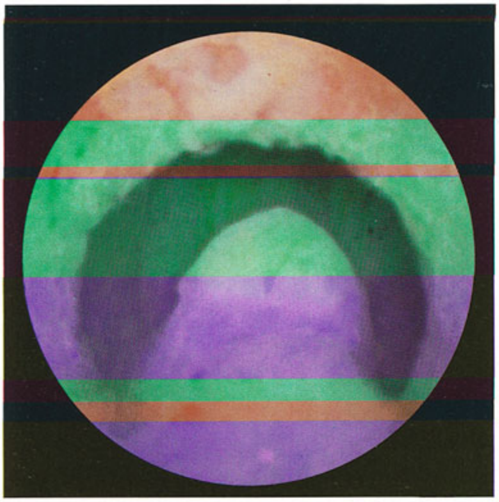

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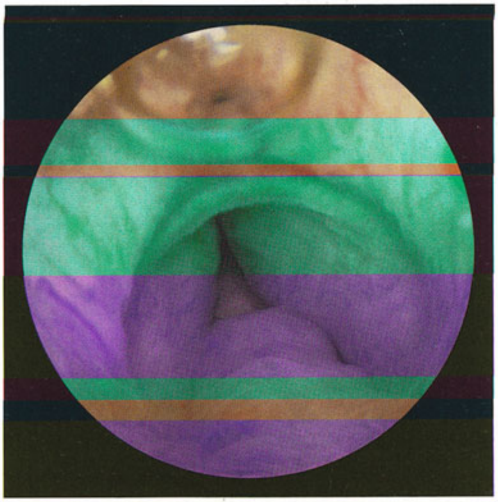

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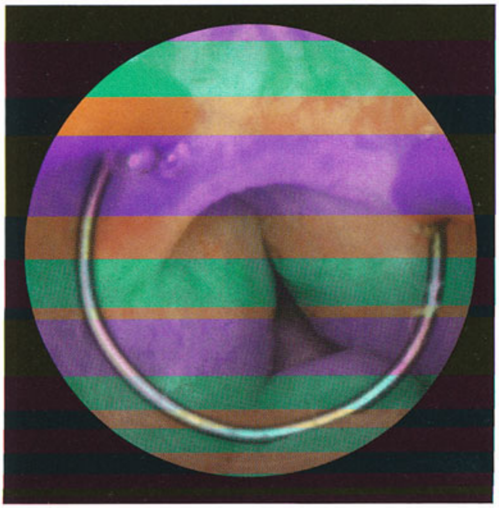

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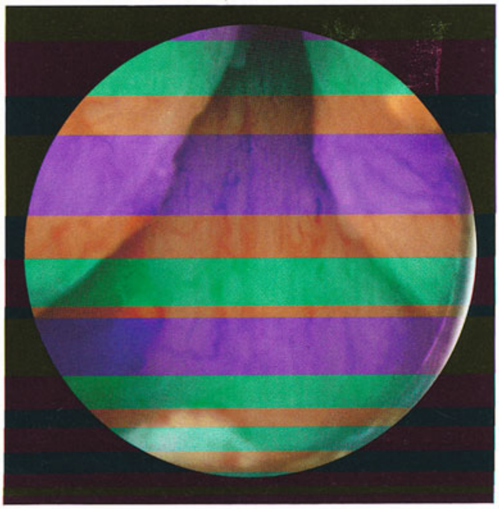

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Ill. 7. Verumontanum, close-up view. The instrument has been tilted down into the prostatic urethra and directed dorsally. This results in the medial surfaces of the lateral lobes being pushed away from the flanks of the verumontanum

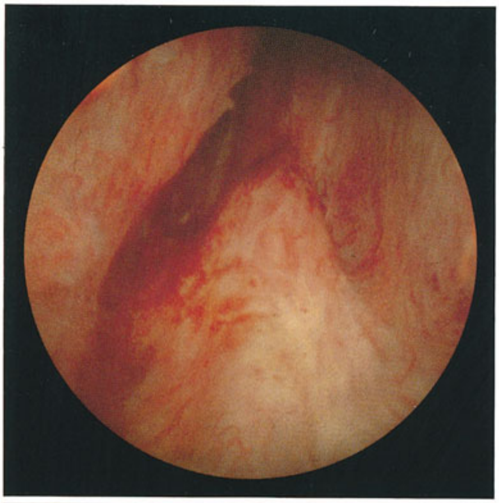
Ill. 8. Close-up view of the cleft between verumontanum (*right*) and the base of the right laberal lobe (left). This cleft is an important landmark for subsequent resection of apical tissue. The boundary line corresponds to the pronounced arcuate fold in the floor of this cleft (same situation as Ill. 6)

Ill. 9. Floor of the prostatic urethra. Close-up view of the cleft between the base of the lateral lobes and the proximal urethral cleft. The verumontanum is no longer entirely visible, lying distally. The orifices of prostatic glands are seen as small, dark slits or dots. On the left of the picture probably an ejaculatory duct

Ill. 10. Further advancement of the instrument up the prostatic urethra in a case of typical trilobe hyperplasia. (2 voluminous lateral lobes and 1 median lobe.) The instrument tends to push the two lateral lobes apart allowing a good view of the median lobe. At the top of the picture a suggestion of the transition to the ventral commissure

Ill. 11. Ventral commissure in a case of predominant lateral lobe hyperplasia. This region is characterized by a few small submucous hematomas which arose during instrumentation

Ill. 12. Ventral commissure in a case of small adenoma with marked pseudopapillary mucosal change. These formations are not true tumors, merely polypoid change of the mucosa, probably trophic in nature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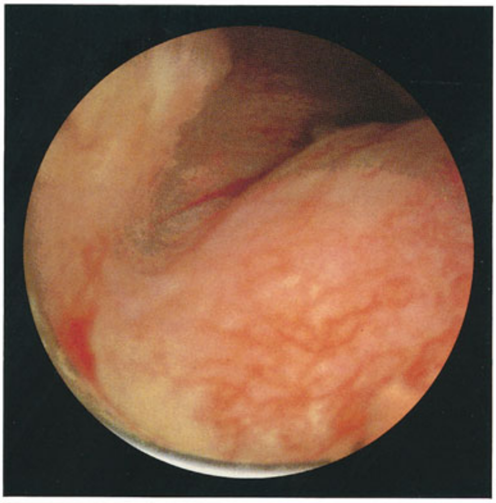
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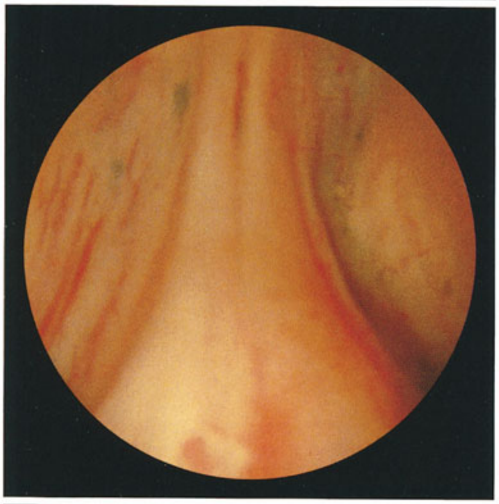
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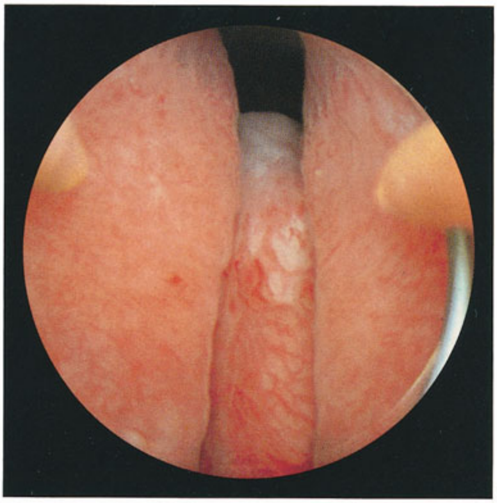
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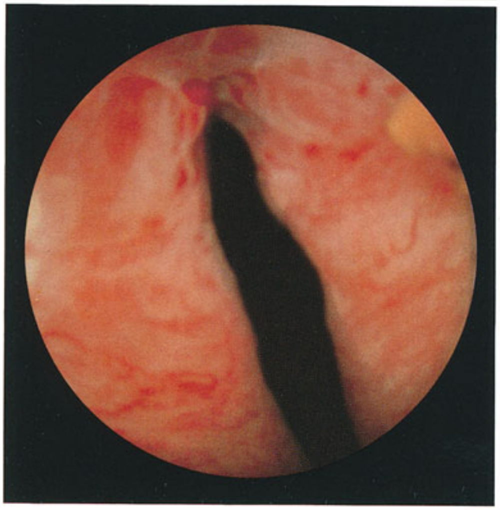
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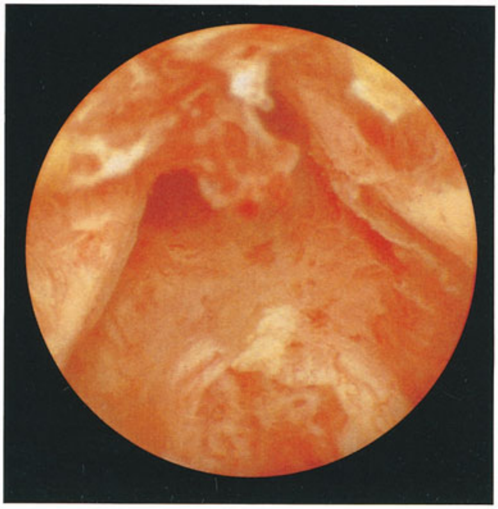
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Ill. 13. Whitish pseudopolypoid change. The villi are poorly vascularized and thus seem pale and transparent. They form at the point of contact between the two lateral lobes

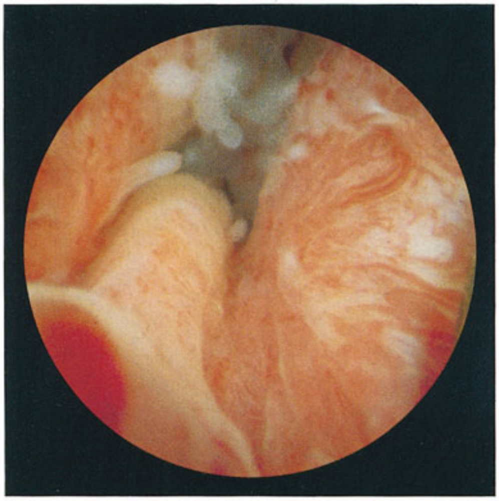
Ill. 14. Small, spontaneous mucosal bridge between the right lateral lobe and the floor of the prostatic cavity. In this case the urethral cleft runs obliquely forwards because of predominant development of the right lateral prostatic lobe. The result is an asymmetrical cleft, a not infrequent observation

Ill. 15. Bladder neck after prolonged catheterization. The mucosa is erythematous and edematous, and in this case the adenoma has pronounced asymmetry. The right lateral lobe is vestigial whilst the left projects far into the urethral lumen. Its ventral portion is particularly pronounced and hangs down from above

Ill. 16. Asymmetrical bladder neck due to bulging right lateral lobe with a distal extension. The cleft of the prostatic urethra is thus rendered oblique and the ventral commissure is somewhat to the left of the midline, as may be seen by comparing its position to that of the verumontanum

Ill. 17. Grade II papillary carcinoma encircling the internal meatus. The tumor has however extended into the prostatic urethra. A tumor carpet covers the summit of the verumontanum and tumor villi hang into the lumen of the prostatic urethra. Only in the 5 o'clock region does a small area of the left lateral lobe remain free of tumor

Ill. 18. Varicosity in the bladder base. Findings of this type are not infrequent in cases of large adenoma where hyperplasia has compressed and obstructed the venous drainage. Nearly all these cases may be expected to bleed profusely at surgery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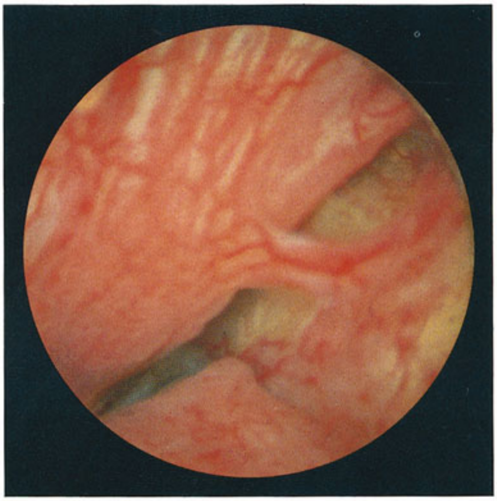
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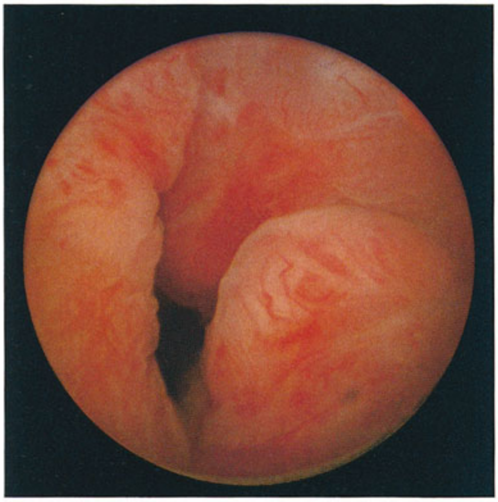
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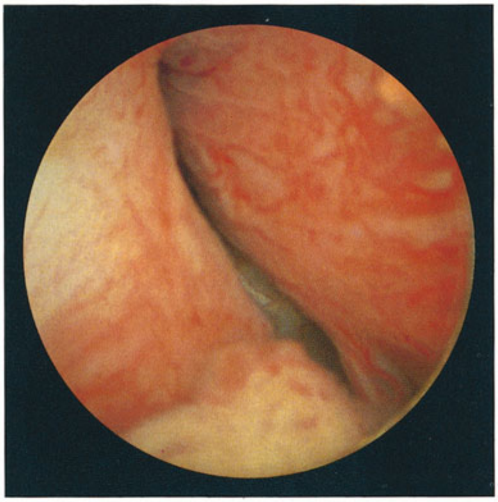
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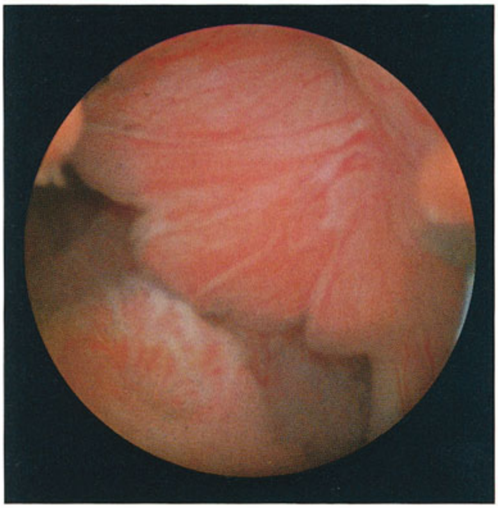
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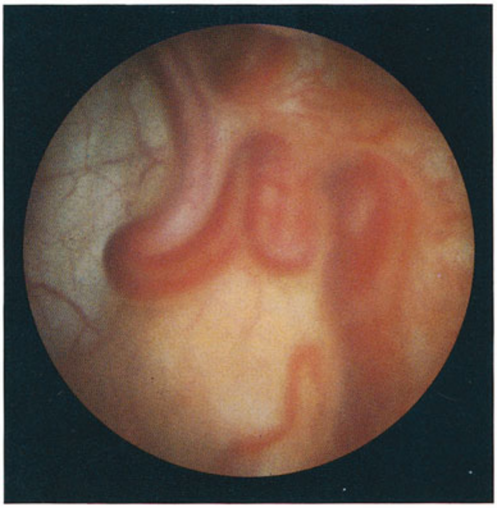
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Ill. 19. Engaging the loop behind a large median lobe. Previous inspection of the vesical aspect ensures that a high interureteric bar will not be injured. In this position the loop will penetrate deeply into the voluminous median lobe. Even its two insulated side pieces have slightly penetrated the tissue

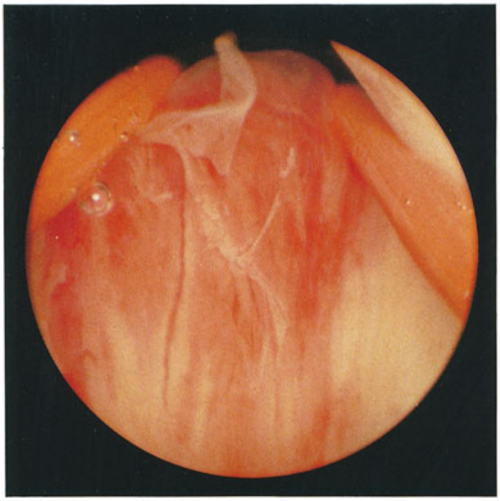
Ill. 20. Shallow initial cut. The length of cut is approximately 1.5 cm as gauged by the size of the loop support. The typical appearance of adenoma tissue is seen, particularly on the *right* as small dots on the surface of the cut tissue

Ill. 21. Engaging the loop for the next cut. The sheath has been somewhat advanced towards the median lobe and the loop passed behind the obstacle in preparation for the next cut. This cut will also remove a considerable quantity of tissue

Ill. 22. Arrangement after these cuts. It may clearly seen how median lobe tissue gradually sinks laterally, robbed of its lateral lobe support

Ill. 23. Arrangement after this next cut. Fibers of the internal sphincter have now been exposed in the region of the internal meatus. The chip from the previous cut is adherent to the loop. Orientation is nevertheless simple as demonstrated by this illustration. The loop is automatically cleaned during a subsequent cut

Ill. 24. Tissue cleft between median and lateral lobes. The removal of large median lobes is facilitated by initially cutting two deep grooves so as to isolate it from its blood supply. The boundary between median and lateral lobe is here clearly marked by the presence of a small fibrin flake. A tangential view of the lateral lobe appears on the extreme *left* of the picture which is dominated by the voluminous median lobe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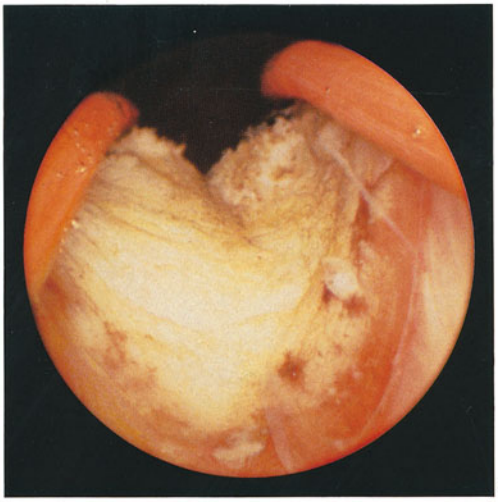
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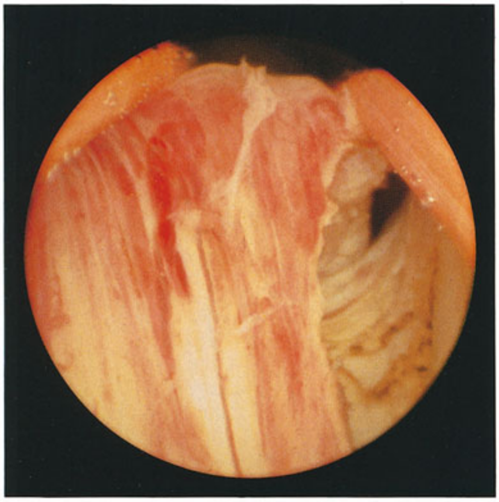
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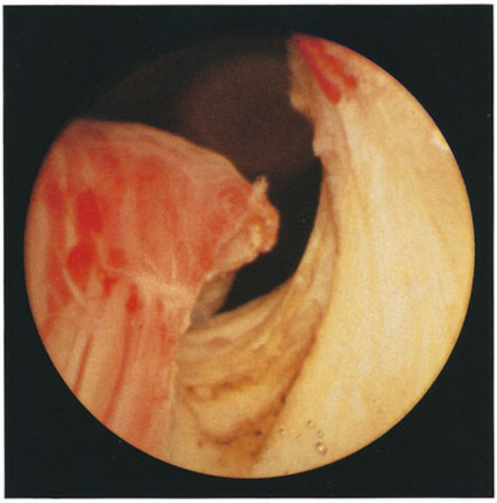
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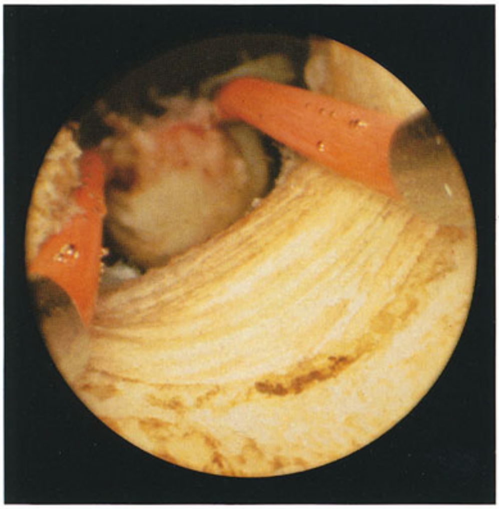
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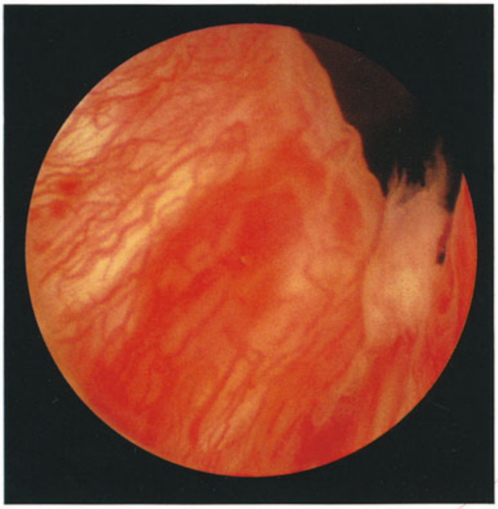
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Ill. 25. Arrangement on completion of the lateral trench. To the *right* of the picture the large median lobe, on the *left* the lateral lobe once again seen tangentially. The trench is cut even deeper in a dorsal direction than is seen on this endoscopic picture. An equally wide and deep groove is cut along the left hand boundary of the median lobe so as to reduce operative blood loss

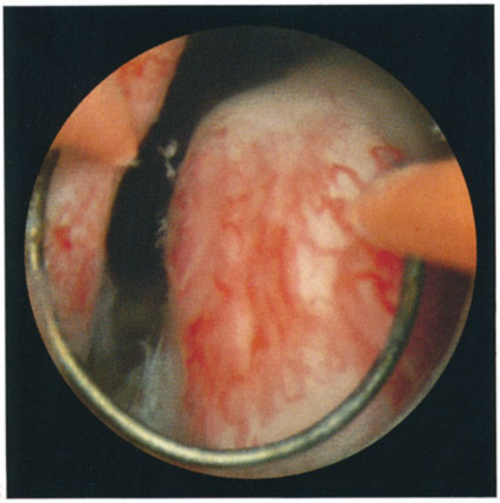
Ill. 26. Retrograde cutting (incision of postoperative bladder neck stenosis). The loop is pressed against the tissue ring, in this case somewhat asymmetrically against the left hand half of the poorly vascular fibrous plate. Cutting current is applied and a cut made towards the bladder

Ill. 27. Arrangement after a retrograde cut. Note that tissue has not been completely separated since these retrograde cuts are not terminated in the usual way by retraction into the sheath. The next cut will be made in the standard fashion back towards the sheath and will completely separate this fragment

Ill. 28. Typical adenoma tissue with fine dots. These result from the avulsion of glandular epithelium by the cutting current. Lateral region of a lateral lobe

Ill. 29. Similar tissue to that in Ill. 28. Less avulsed glandular epithelium is seen. View from the floor of the prostatic capsule in the region of the median lobe

Ill. 30. Copious secretion within gland ducts. In this case the glandular epithelium avulsed by the cutting current no longer appears as dots but forms a coarsely fibrous surface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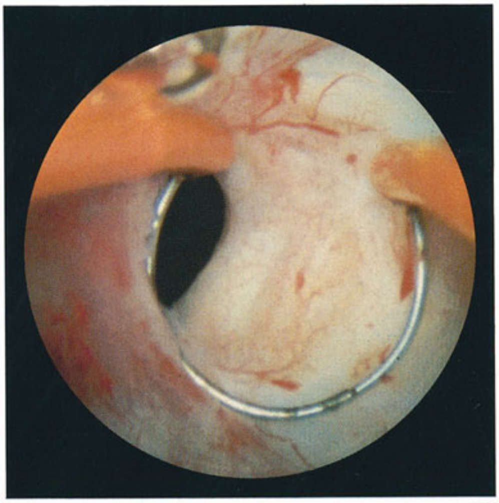
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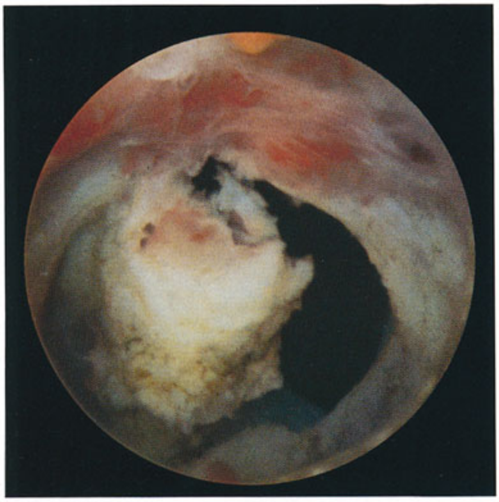
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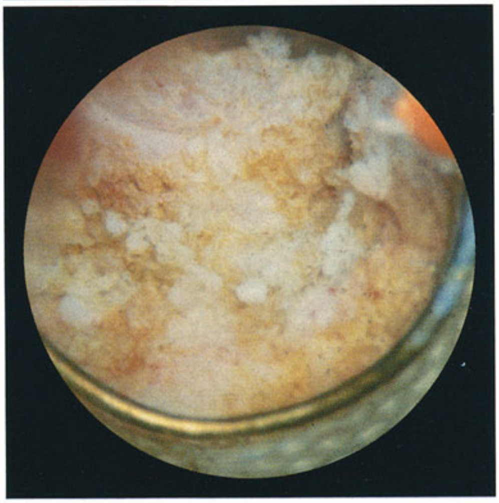
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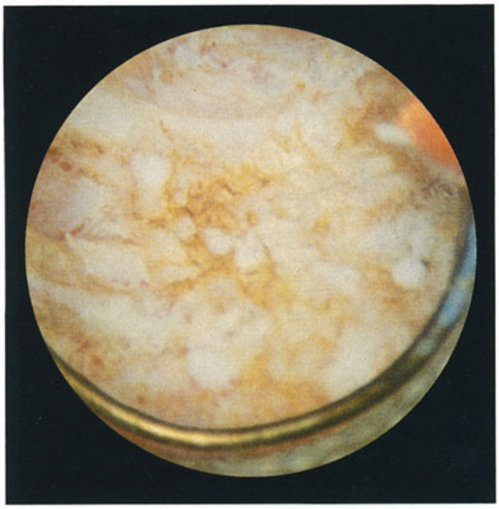
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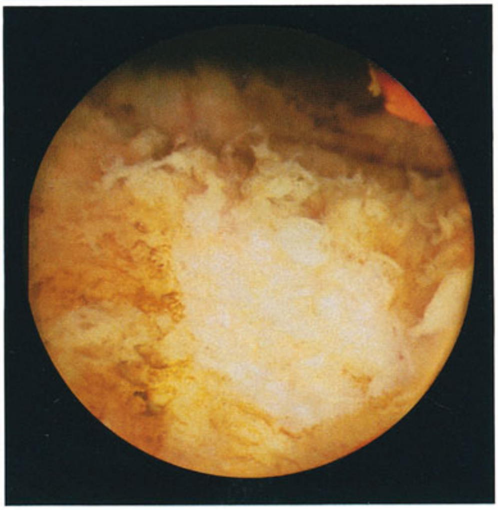
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Ill. 31. Transition from capsular to adenomatous tissue. Same patient as Ill. 30. Once again glandular tissue bulges into the lumen in the characteristic fashion as it is removed from its normal surroundings. The difference between the rigid capsular tissue in the background and this protuberant adenoma tissue is easily seen

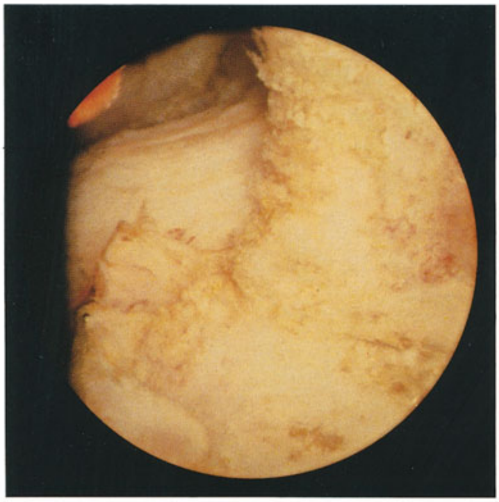
Ill. 32. Transition from capsular to adenomatous tissue in a case of poorly glandular hyperplasia. Once again the cut surface of adenoma bulges into the urethral lumen. Poorly glandular, mainly connective tissue hyperplasia

Ill. 33. Overall view from a retracted instrument to show the general topography of internal sphincter, adenoma tissue and, in the foreground, the verumontanum (same patient as Ill. 32)

Ill. 34. Tissue surface in a case of prostatic carcinoma without visible gland ducts. In contrast to the tissue previously shown this surface is smooth and featureless. The rigidity of the tissue may be appreciated from the fact that it has kept its shape after the first cut. The ridge between successive cuts clearly demonstrates this behavior

Ill. 35. Prostatic carcinoma. The once again poorly vascular tissue has a smooth surface, only three typical ducts being seen in the *center* of the picture. On the *right* running radially towards the center of the picture note a somewhat more vascular region with a few minute vessels

Ill. 36. Fibrous, bladder neck stenosis following previous resection. In contrast to the two previous illustrations of a carcinoma note the parallel fibers of the connective tissue. A certain amount of experience is needed to distinguish these two appearances



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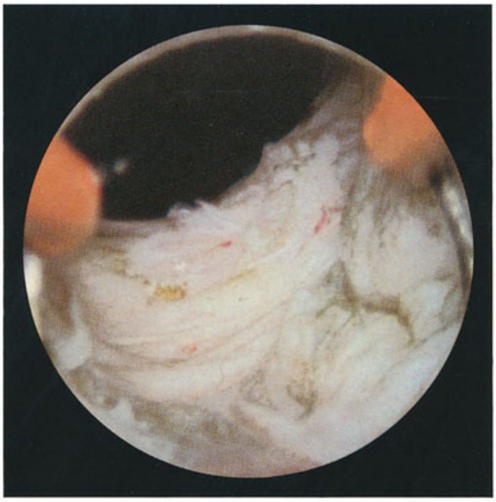

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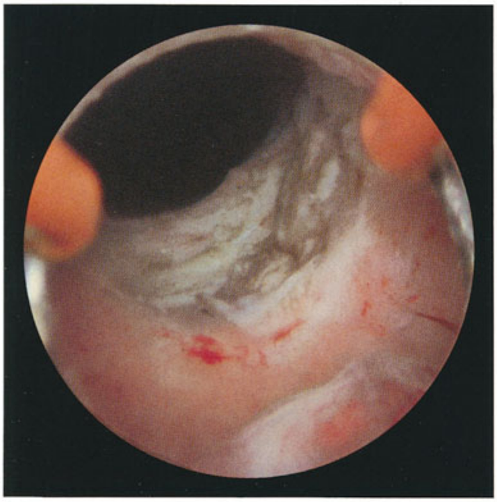

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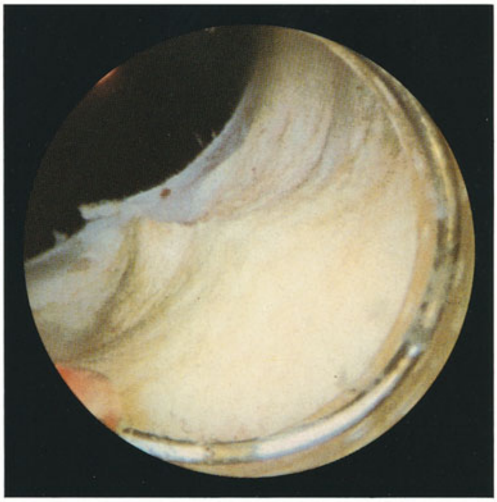

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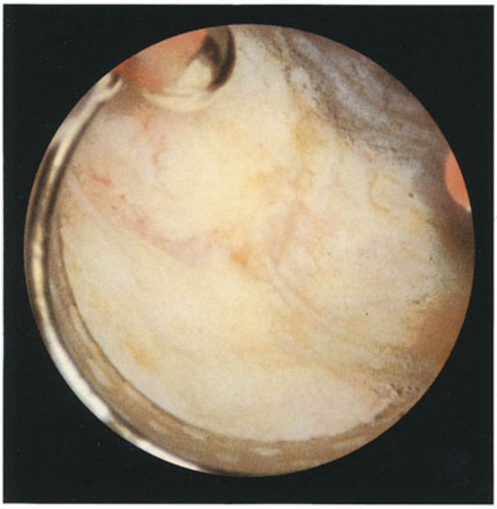

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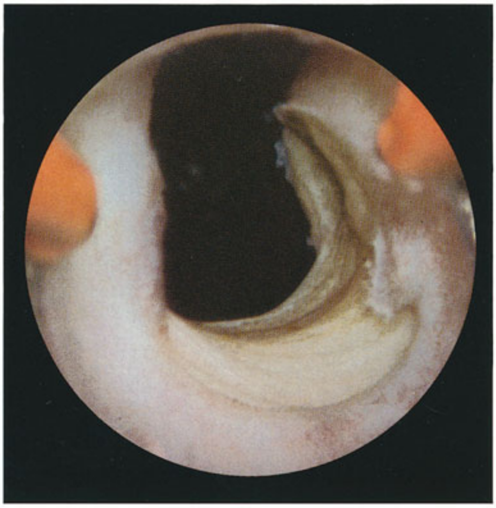

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Ill. 37. Fine fibers of the internal sphincter at the transition between prostatic cavity and bladder. The fine parallel fibers are easily appreciated in this picture. By close approximation to the front lens of the telescope their size has been somewhat exaggerated

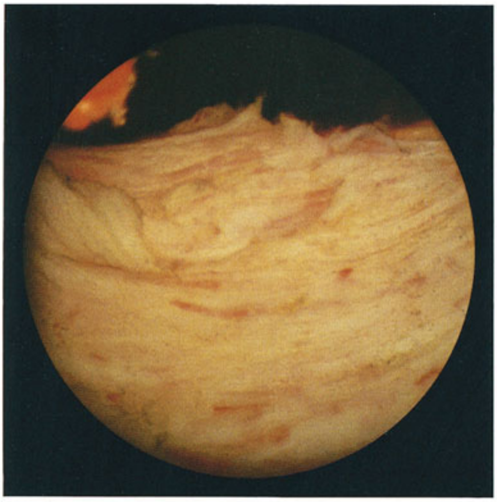
Ill. 38. Fibers of the internal sphincter, approximately in the 5 o'clock region of the internal meatus. In this region the parallel fibers tend to separate. At one point this may be clearly seen as a reddish stripe. This fiber separation frequently results in the formation of true clefts

Ill. 39. Internal sphincter region clearly showing separation of muscle fibers and cleft formation

Ill. 40. Typical appearance of the prostatic capsule in the 7 o'clock region. These fibers are parallel and appear somewhat finer than in typical cases (increased distance from the lens). This increased distance was chosen to demonstrate the curvature of the cavity. At the front margin of the picture between 6 and 8 o'clock note individual small yet clearly visible prostatic glands

Ill. 41. Close-up view of the prostatic capsule. Adjacent to the cutting loop the area where a large vessel has been coagulated. The typical coarse structure of the prostatic capsule is better seen in this picture

Ill. 42. Opening a prostatic abscess during transurethral resection. The pasty, inspissated secretion of this abscess exudes from the opened cavity into the lumen of the prostatic urethra. In order to guarantee free drainage this opening was widened by a further corrective cut. Such old, inspissated abscesses are usually clinically silent



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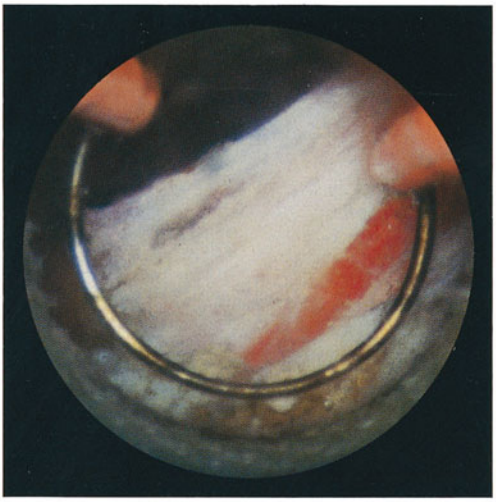

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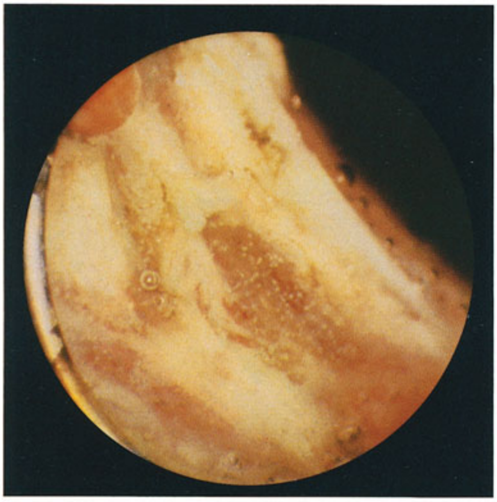

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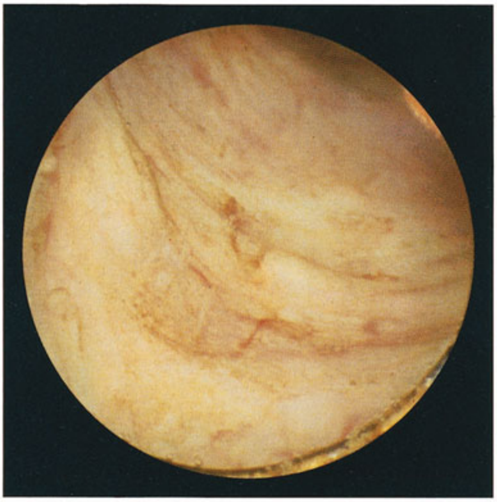

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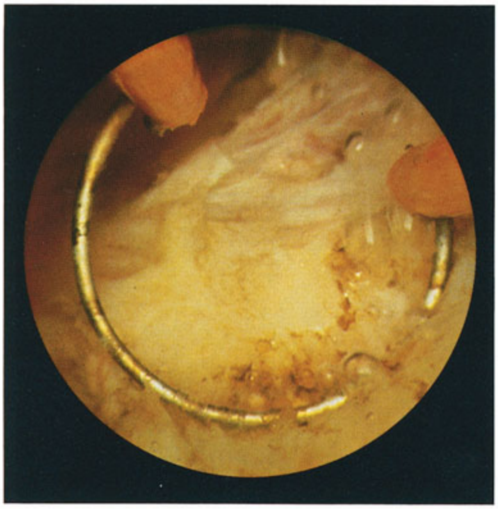

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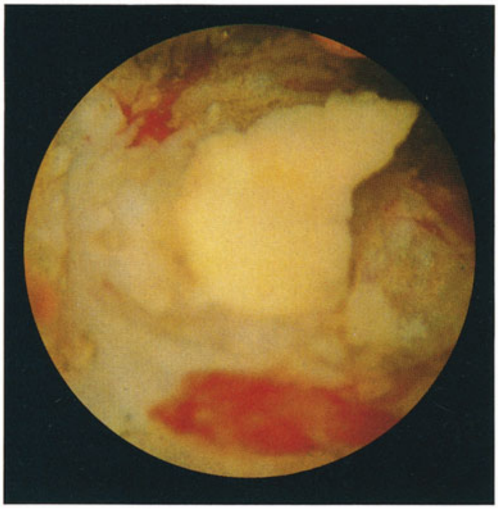

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Ill. 43. Coincidental transection of seminal vesicle. In the right hand lumen brownish yellow epithelial lining is clearly seen. It is surrounded by circular connective tissue. At the right hand margin of the picture, somewhat higher, a few small prostatic glands

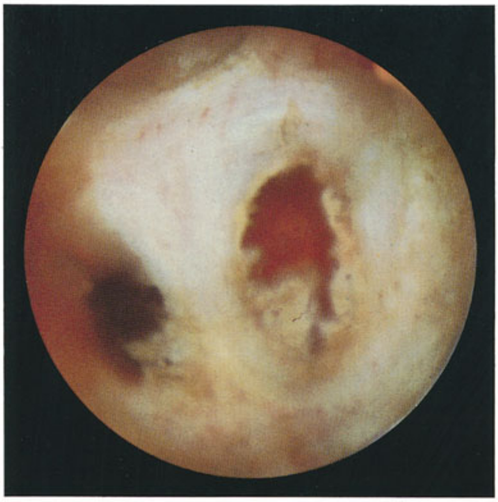
Ill. 44. Prostatic calculi. Large concretions lying in a nest have been exposed by the loop which is now being used to lever them out

Ill. 45. Configuration after extracting a calculus. The bed is clearly seen, lined with only moderately inflamed mucosa

Ill. 46. Configuration after excessively distal resection resulting in complete incontinence. In this case the surgeon has proceeded too far distally beyond the verumontanum and carried his cut down into the depths of the sphincter muscle. The two lateral lobes are still largely intact. Pseudopapillary villi denoting edematous trophic change

Ill. 47. Typical large artery hemorrhage in the 9 o'clock region, fairly close to the internal meatus. Note gaping of capsular tissue in the region of this large vessel which is accompanied lower down by a small arterial twig. Maximum irrigating flow is required to keep the operative field clear and visible, and the blood jet is therefore washed upwards towards the bladder. The vessel is surrounded by a small cuff of fatty tissue, present around virtually every large artery

Ill. 48. Same region of the operative field following hemostasis. The localized crust is easily seen. The vessel lumen lies between the three small air bubbles and the cutting loop, where it may be seen as a white dot. The region of coagulation runs parallel to the tissue fibers and is somewhat wider than necessary because of the diameter of the loop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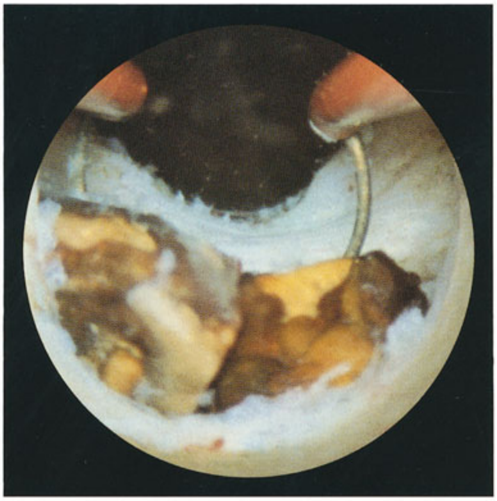
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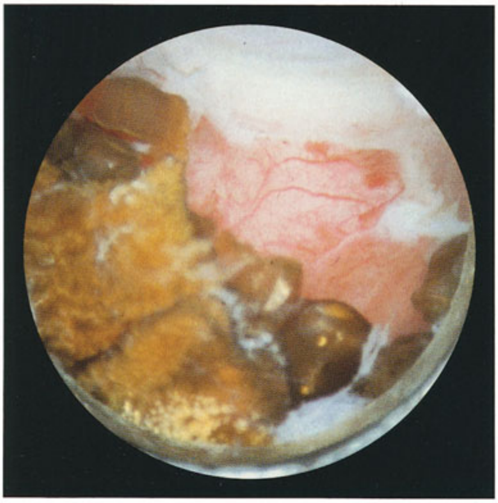
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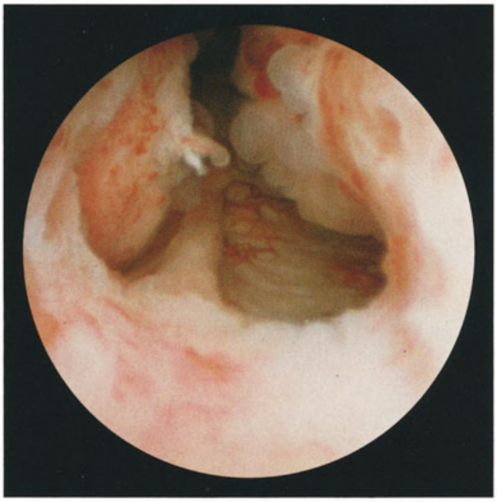
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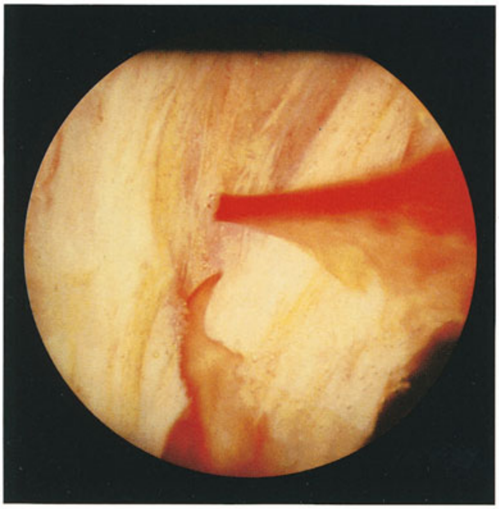
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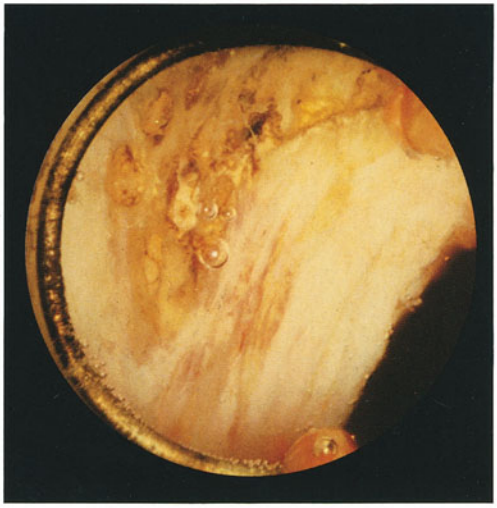
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Ill. 49. Large artery in the right lateral wall of the cavity close to the internal meatus at 7 o'clock. This shows the fat layer constantly present around large arteries particularly well. The lens has been closely approximated to the vessel, thus giving an enlarged impression of prostatic capsular fibers. Once again good visibility and recognizability of structural detail have been preserved. A red cloud of blood is generated by the impact of the blood jet on the opposite side of the cavity

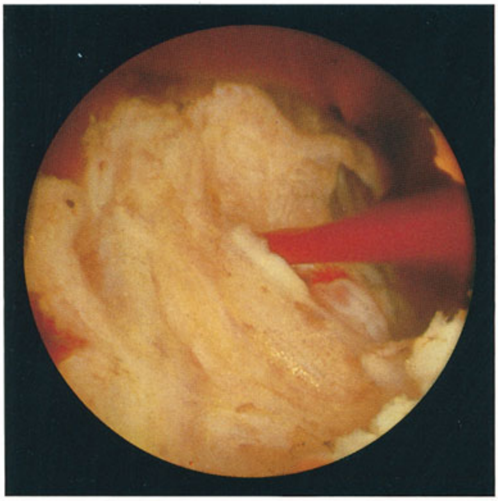
Ill. 50. Small artery in the 9 o'clock region close to the internal meatus. The irrigating flow has now been reduced so as to maintain a good view of the vessel. This state of affairs is confirmed by the wisps drawn out of the end of the blood jet

Ill. 51. The appearance of various sizes of blood vessel. Adjacent to the medium large artery lying between the 2 and 5 o'clock regions of the internal meatus are also seen a few small vessels, only visible because of marked reduction in irrigating flow. Once they have been thus demonstrated these vessels are easily closed by touching them with the resectoscope loop

Ill. 52. Small adventitial capillaries bleeding around a venous sinus. The lumen of the venous sinus lies open to inspection of the cleft *in the middle* of the picture, whilst four small minute vessels are seen bleeding *to the right.* Note again the influence of irrigating flow on the appearance of bleeding points. Pressure was exercised on the surrounding tissue with the sheath aperture to prevent hemorrhage from the venous sinus whilst this photograph was taken

Ill. 53. Large venous sinus opened obliquely. View from above into the lumen. Once again pressure on the surrounding tissue has temporarily halted hemorrhage

Ill. 54. Apical region as seen with the bladder empty. The resectoscope lies distal to the verumontanum. The lateral lobe residues closely approach each other in the mid-line. The right-hand lateral lobe has been more or less removed but a large proportion of the left-hand lobe remains to be excised



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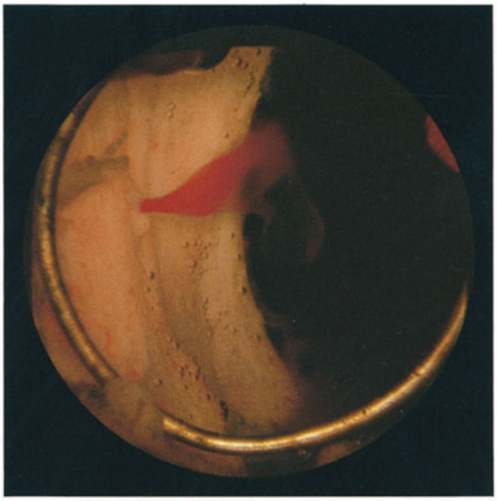

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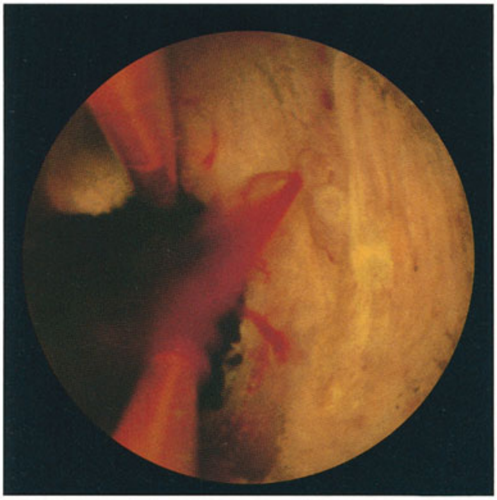

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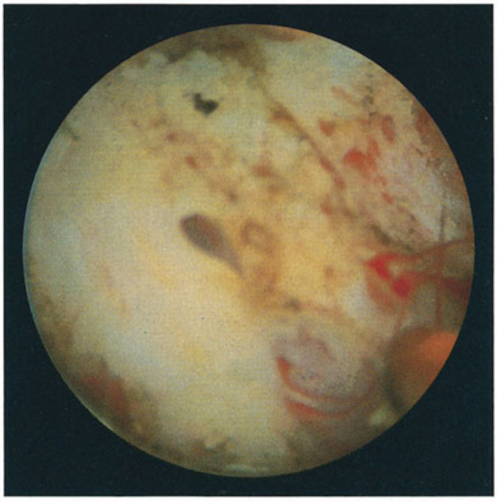

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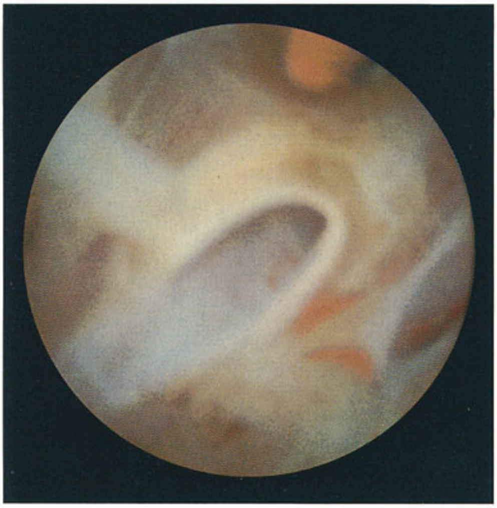

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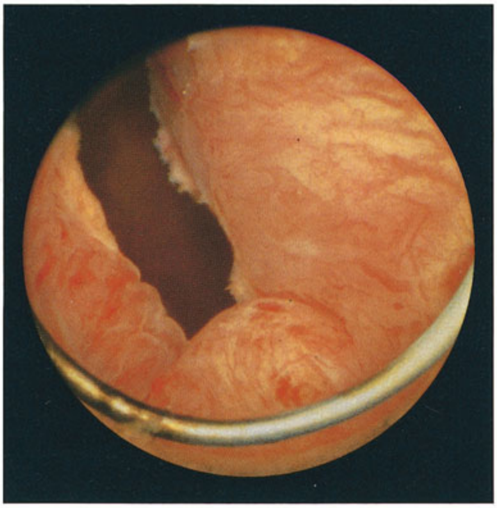

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Ill. 55. Same patient and same resectoscope position as Ill. 54, with the bladder fully distended. The apical residues have almost completely disappeared from the field of view. The left lateral lobe has been completely pushed out of the field and no longer represents an impressive tissue bulk, despite the considerable amount of tissue remaining to be removed. Lateral displacement of the lateral lobe residues renders the cleft between verumontanum flank and the medial margin of the left lateral lobe clearly visible. This cleft is partly covered by the resectoscope loop

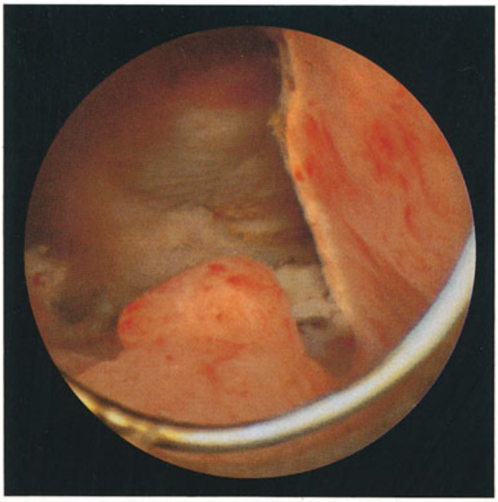
Ill. 56. Inadequate dissection of the apical region. Although ventral portions of the lateral lobes have been ablated, a bilateral apical residue remains in the paracollicular region partly covering urethral cleft and verumontanum. This is the typical appearance of the paracollicular region prior to its clearance. The convex configuration of the lateral lobe, clearly seen **on the right** is characteristic of this stage

Ill. 57. Lowering the resectoscope into the cleft between verumontanum and lateral lobe. The sharp margin of the residual apical tissue is typical for the appearance of the field through a 0° telescope and appears here in bright contrast against the dark background of the prostatic cavity. The presence of mucosa and the appearance of the tissue are the main landmarks for working in this region. In this case complete removal of apical tissue required the instrument to be lowered into the cavity by raising the eyepiece and swinging it to the right. No further mucosa may be resected, since the capsular margin has already been reached

Ill. 58. Paracollicular tissue in close-up view. The two basal lateral lobe residues lie closely against the urethral crest and the verumontanum, partly covering them. Once again the margin of resection is clearly seen against the background of the cavity. Cutting in this region always requires 'dipping' of the loop into the cavity with placement of cuts parallel to the capsular wall. In this region the capsule rises up sharply to reach the level of the urethra

Ill. 59. Typical position of the loop during resection of this region. A small wedge-shaped piece of tissue is removed by a 'nibbling' cut. Tissue is wedged between loop and sheath aperture

Ill. 60. Final inspection of the resection field. The resectoscope sheath has been retracted distally. This allows residual tissue fragments to hang down into the field of view, as seen here at 12 o'clock



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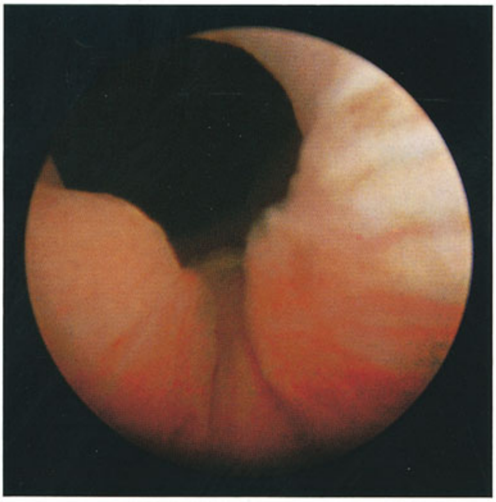

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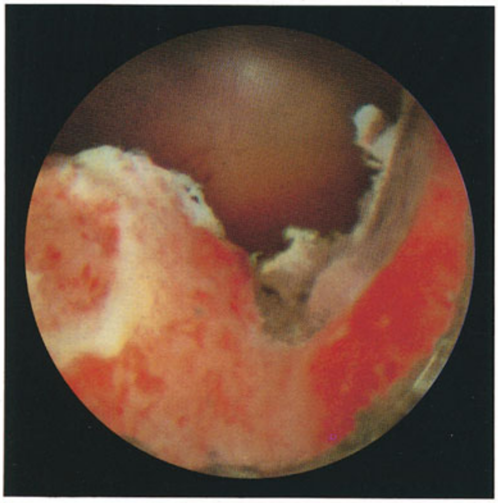

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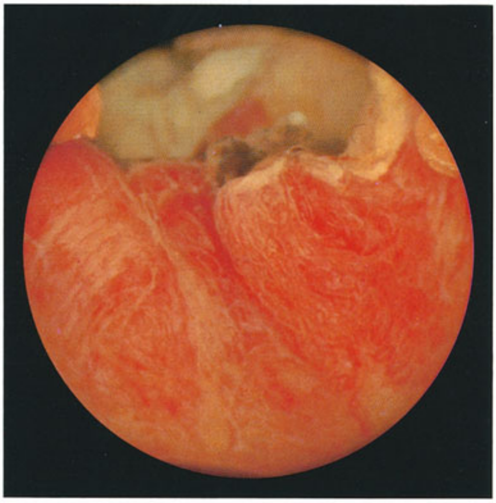

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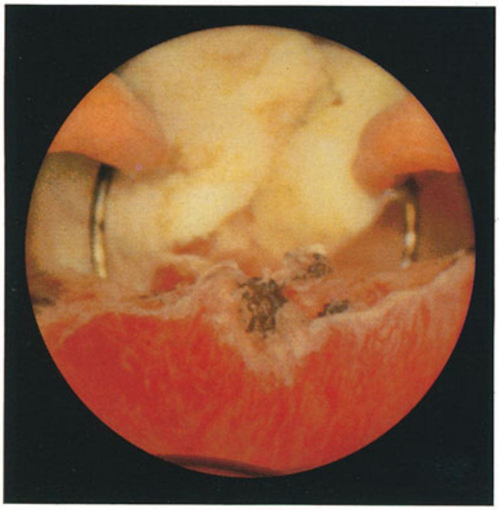

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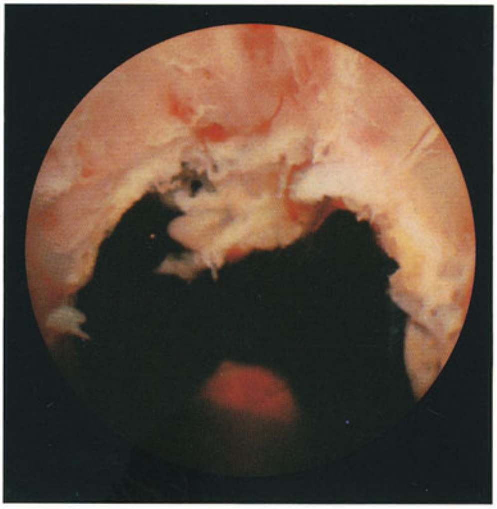

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Ill. 61. Final inspection of the paracollicular region with the bladder empty. A small lateral lobe residue remains. A further cut as shown in Ill. 59 will be required for its removal

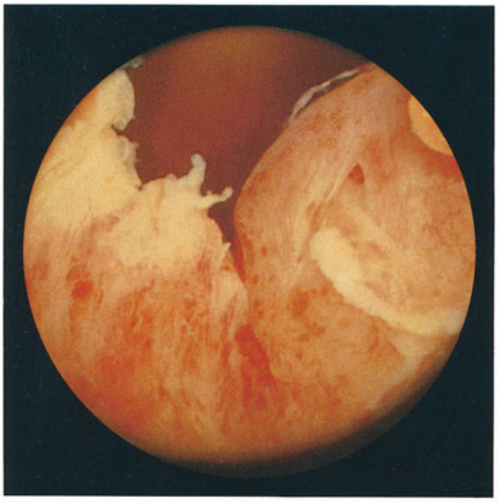
Ill. 62. Final arrangement at the end of resection. Note how the urethral mucosal margin almost completely encircles the verumontanum when the bladder is empty

Ill. 63. The bladder is fully distended and the verumontanum sinks down onto the floor of the cavity as the urethral ring opens

Ill. 64. Papillary carcinoma of the bladder on the posterior wall. Finely villous tumor (histology: papillary carcinoma Grade I), approximately the size of a small cherry. Normal intact mucosa surrounds the tumor

Ill. 65. Papillary carcinoma of the bladder neck. In the foreground around the internal meatus a carpet of tumor of basically papillary structure covers the distal bladder vault and is growing down into the internal meatus. In the background a second small tumor is clearly seen at the junction of vault and posterior wall. Tumors of this type often go unnoticed if the vault is not pressed down and inspected with a right angle or retrograde viewing telescope. They are usually resectable without any problem under muscle relaxation with counterpressure on the vault as shown in this picture. The small tumor on the posterior wall was also ablated and sent for histology

Ill. 66. Total papillomatosis of the bladder. Cases of this type in which no normal area of mucosa is frequently visible, require considerable endoscopic experience if they are to be removed transurethrally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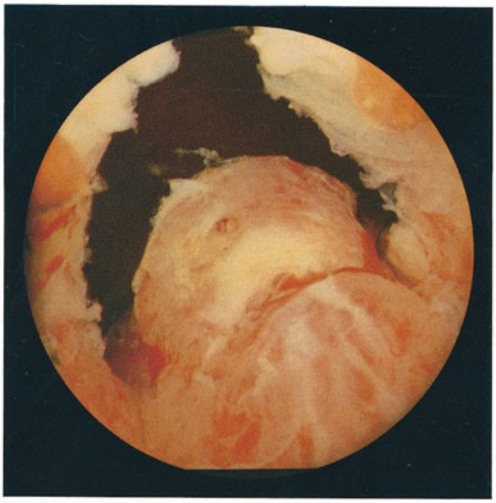
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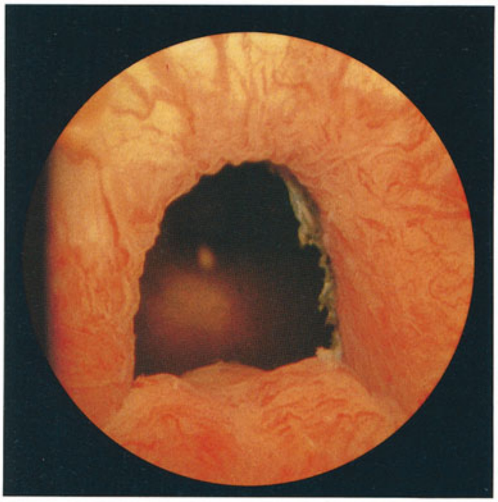
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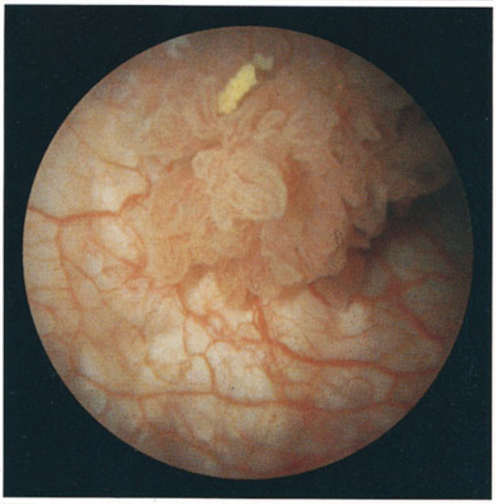
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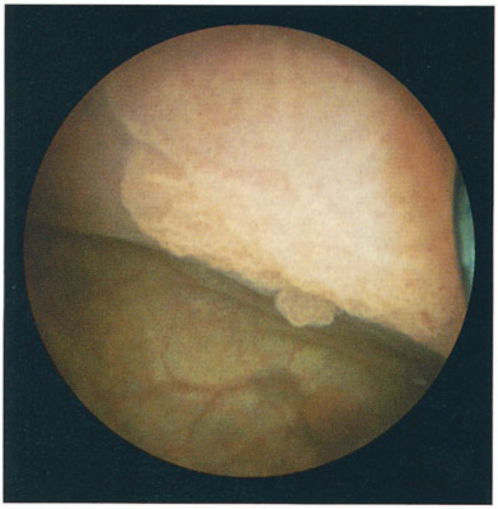
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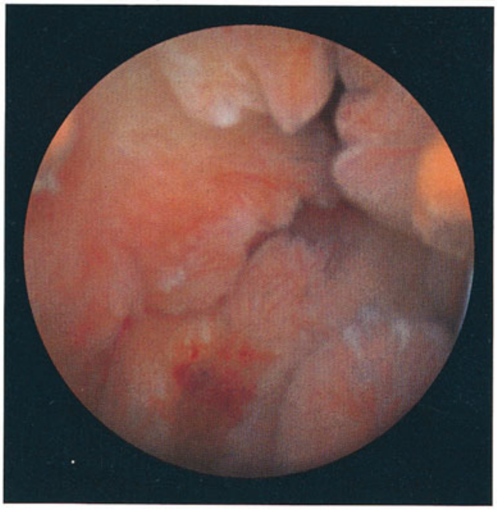
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Ill. 67. Papillary carcinoma Grade II–III on the base of the bladder. The surrounding mucosa is disturbed, erythematous and thrown into folds. Dynamic cystoscopy reveals rigidity of the tissue around the tumor base. Cases of this type must be assessed by removing a large number of tissue samples both from the depths and the periphery of the tumor region if its true extent is to be recognized

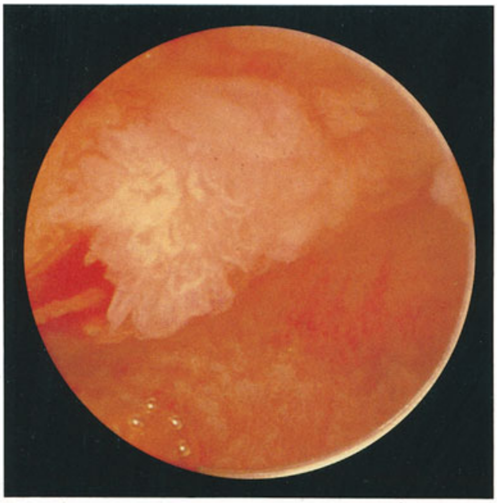
Ill. 68. Typical appearance of bladder wall musculature during transurethral resection of a non-infiltrating bladder tumor. Loose connective tissue is seen between individual muscle fibers. There is no trace of tumor infiltration

Ill. 69. Appearance after ablation of a further layer of tissue. Muscular elements become sparser. The connective tissue assumes a cobweb appearance. This stage precedes perforation and requires great care

Ill. 70. Transurethral resection of an infiltrating carcinoma. *At the lower margin* of the picture note tumor infiltration of the muscle. The tissue appears filled with putty-like substance and individual bladder muscle fibers can no longer be distinguished, although their structure is intact. *At the upper margin* the muscle remains normal, individual fibers are delicate and easily seen

Ill. 71. Further tumor resection. In one area perivesical fat has already been reached (at 3 o'clock) (controlled perforation). Further dissection of this region during the first sitting would lead to free perforation of the bladder. If tumor cells are proven to be present in the deepest layers, the procedure could be either extended by laser coagulation of the region or by repeat resection some days later. By this time inflammatory change will have firmly attached perivesical fat to the bladder wall (same patient as Ill. 70)

Ill. 72. Typical appearance of perivesical fat. Fat is seen glinting through between residual muscle fibers. This shimmering in the illuminating light is typical



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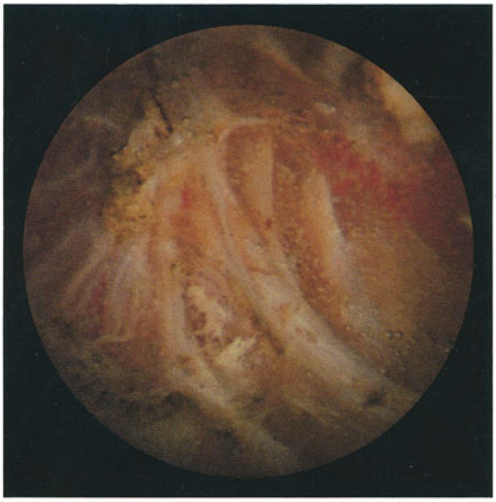

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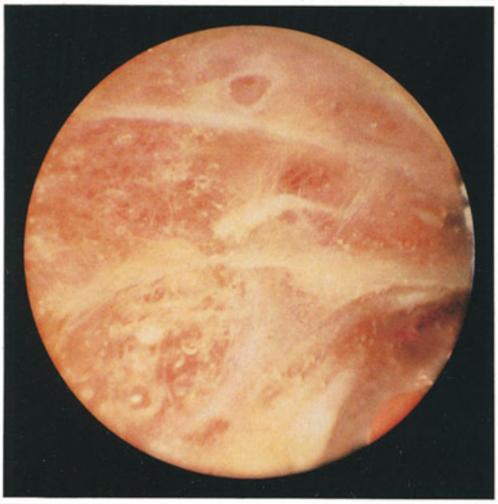

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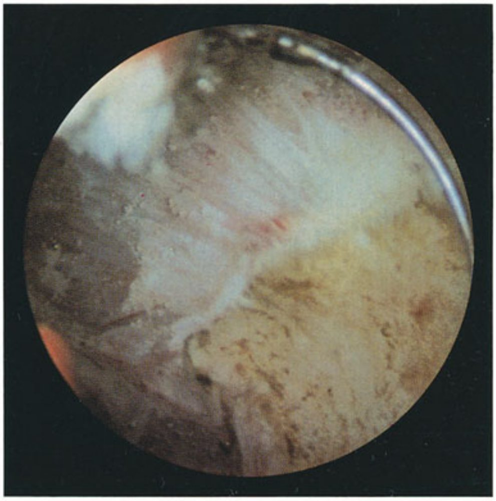

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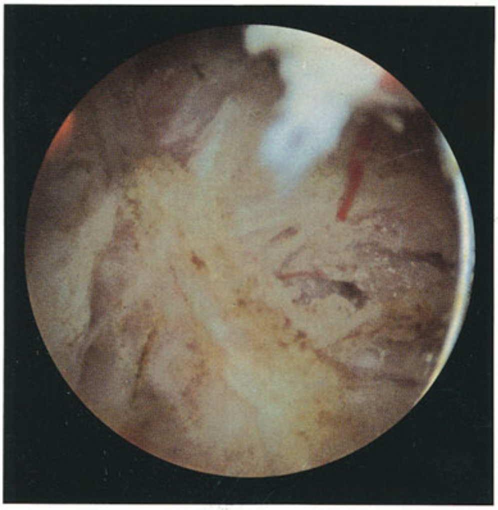

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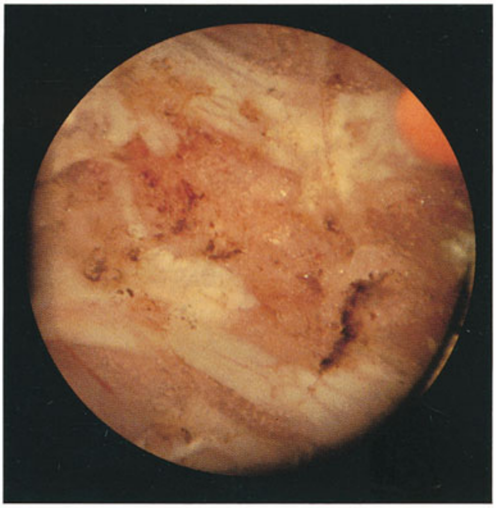

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Ill. 73. Use of the mowing loop. The loop has been applied to the periphery of a tumor and will be used to excise it tangentially and parallel to the bladder wall

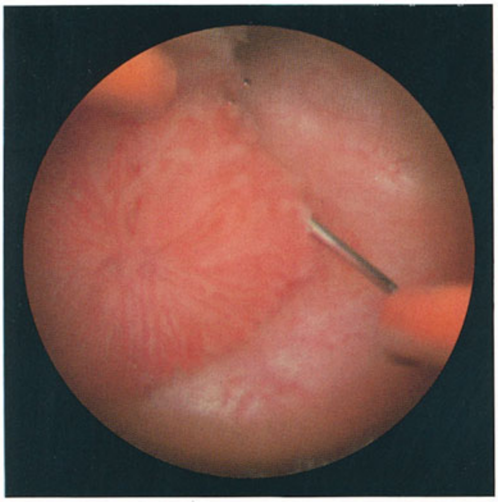
Ill. 74. Appearance after tumor excision with the mowing loop. In the area shown here the mucosal margin is being coagulated with the loop to staunch hemorrhage from fine vessels entering the resection field

Ill. 75. Resection of a tumor partly infiltrating muscle close to the ureteric orifice. The orifice has been completely cleared of tumor. The mucosal lining of the ureter bulges into the bladder in a cuff. Most of the muscular valve mechanism is intact. Cases of this type tend to heal without progressing to reflux, although part of the terminal ureter was ablated and sent separately for histological examination

Ill. 76. Transurethral resection of a papillary carcinoma of the bladder in the region of the ureteric orifice. Further resection reveals that the ureter contains a mass of tumor. The orifice is marked by passing a ureteric catheter. The margin between ureter and bladder muscle (Waldeyer's sheath) is clearly seen as a cleft. The patient was subsequently treated by nephroureterectomy and local excision of a cuff of bladder

Ill. 77. Healed ureteric orifice after resection of an adjacent tumor. The region of the orifice has healed with scar formation leaving a rigid and refluxing ureter. The significance of such reflux will depend on general condition, age and recurrence tendency of the tumor

Ill. 78. Healed resection field after removal of papillary carcinoma from the margin and fundus of a bladder diverticulum. During surgery the mouth of the diverticulum remained wide and allowed good access into the diverticulum. Healing has led to cicatricial stenosis of the diverticular orifice. Nevertheless endoscopic inspection of the diverticulum remains possible



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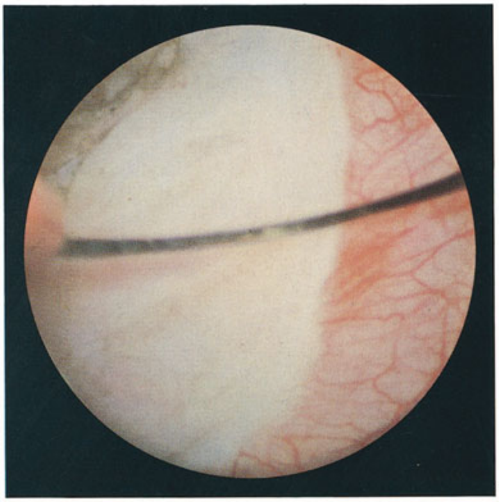

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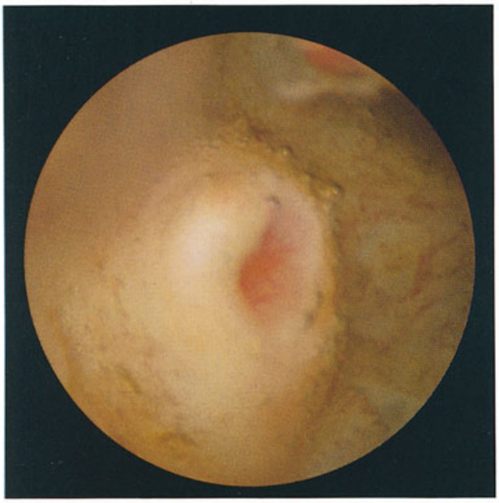

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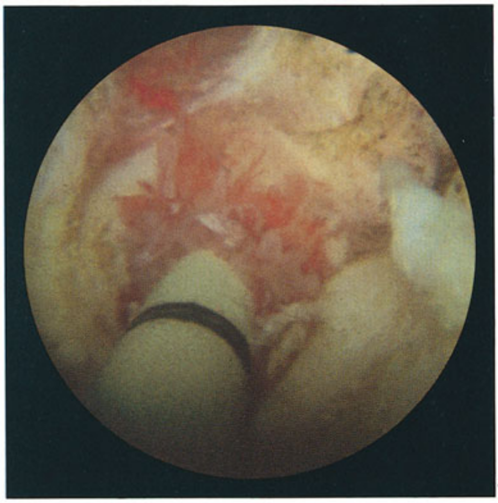

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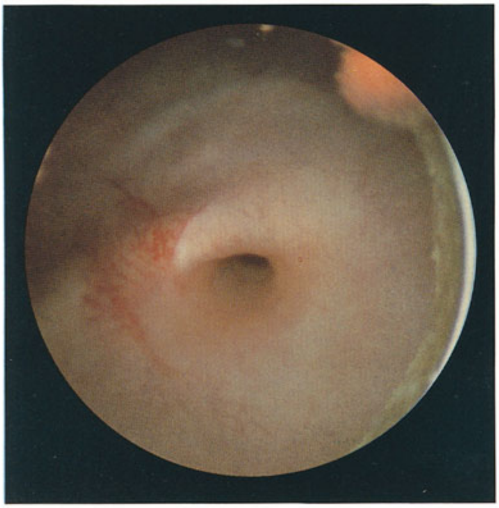

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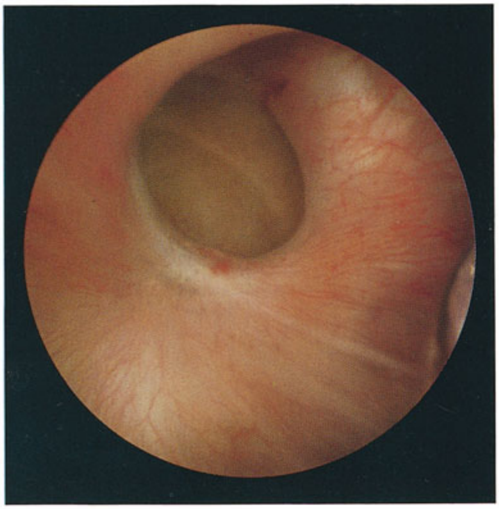

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Ill. 79. Endoscopic appearance of viewing urethrotomy. The scalpel is being advanced towards the scar plate for an initial incision in the 12 o'clock position

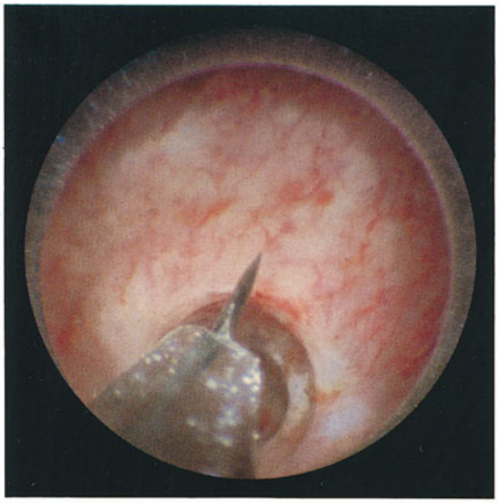
Ill. 80. After incision at 12 o'clock the urethra is somewhat widened. Note whitish poorly vascular scar tissue fibers

Ill. 81. Viewing urethrotomy around the sphincter. Division of a cicatricial ring immediately beneath the sphincter, the latter seen posteriorly. The stricture was so pronounced as to allow the cut surface of scar tissue to virtually encircle the lumen

Ill. 82. Cicatricial bladder neck stenosis following TUR of the prostate. At 6 o'clock the large verumontanum, view into the prostatic capsule showing the small opening through which it communicates with the bladder

Ill. 83. Sphincter test of Hartung. In the so-called 'hydraulic sphincter test' the suspected region of the sphincter is kept under observation whilst the irrigating flow is abruptly interrupted and restored. The sudden pressure changes thus provoked by variations in irrigation flow excite obvious circular contraction in the region of the sphincter. The region shown to contract corresponds to that responding to faradic stimulation

Ill. 84. Sphincter test of Tammen and Hartung. Prolonged stimulation with faradic current leads to virtually complete occlusion of the urethra. This test is also of diagnostic value in relation to incomplete sphincter trauma such as may occur following transurethral or open surgery to the bladder neck. The test also reveals rigid fibrous segments of the urethra which arise by connective tissue replacement of muscular elements with consequent loss of contractility



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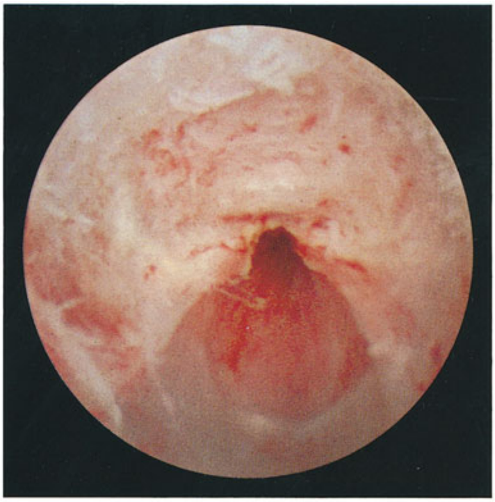

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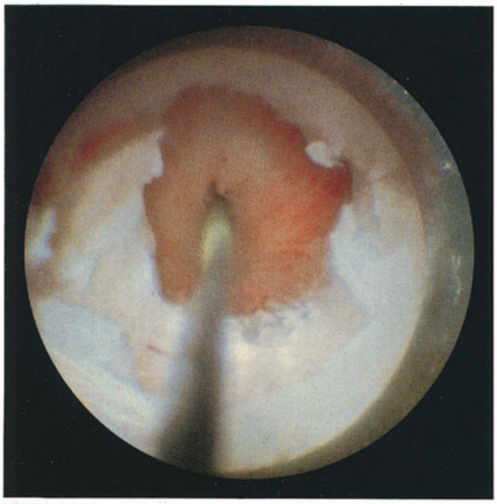

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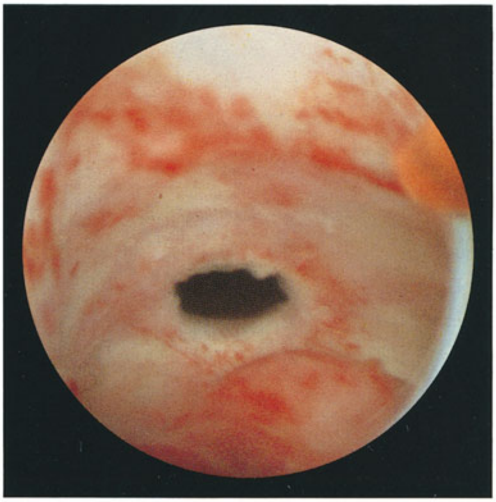

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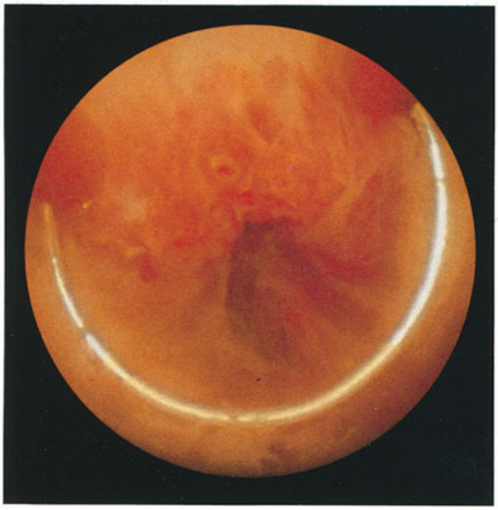

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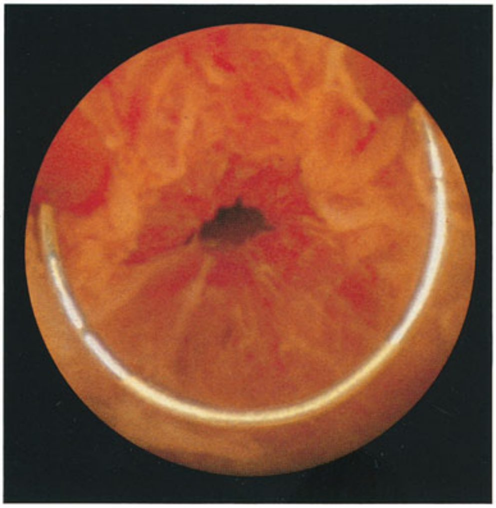

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